I2C DRV2605L Haptic Motor Controller Module

DEVLAB FACTOR

Mfr. Part #: UE0065

Product Reference Manual (V1.0)

Description

The **DevLab DRV2605L Haptic Motor Controller Module** is a compact, precision-engineered board designed to generate realistic and programmable vibration feedback in embedded systems. At its core lies the **DRV2605L** from **Texas Instruments**, a state-of-the-art haptic driver that combines analog and digital control to deliver smooth, consistent, and highly tunable tactile sensations.

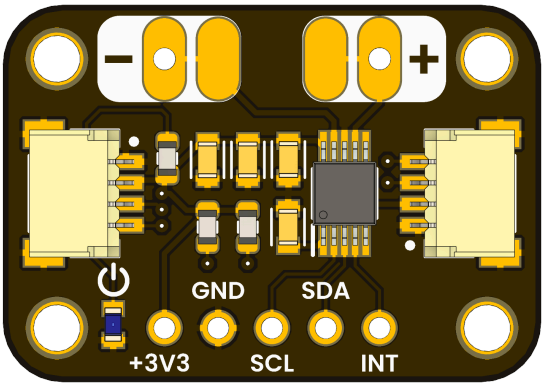
This module supports Linear Resonance Actuators (LRA) and Eccentric Rotating Mass (ERM) motors, allowing designers to create delicate taps to complicated vibration sequences. Over 100 pre-defined vibration effects, including click, ramp, pulse, buzz, and double-click patterns, are available through easy I²C instructions in its integrated waveform library.

A built-in **Auto-Resonance Calibration (ARC)** feature allows the DRV2605L to adapt to different actuators by automatically detecting their resonance frequency and adjusting the drive waveform for optimal efficiency and performance.

This results in consistent tactile feedback across temperature changes, battery conditions, and actuator variation

DevLab format compatibility.

Simplicity and compatibility are the core principles of the **DevLab form factor**. This standard defines a **compact and communication-optimized board layout**, ensuring straightforward connection and interoperability among DevLab module



Key Features

- **I²C Interface** — Simplified communication with most microcontrollers and SBCs.
- **Wide Supply Range** — Operates from **3.3 V – 5 V**, ensuring broad platform compatibility.
- **Plug-and-Play Connectivity** — Equipped with **1 mm JST 4-pin connectors**, compatible with **STEMMA QT** and similar ecosystems for fast prototyping.
- **Advanced Haptic Engine** — Integrated **vibration effect library**, real-time playback, and automatic resonance calibration.

Hardware Features

- **DRV2605L haptic driver** supporting LRA and ERM motors
- **I²C interface** for easy control with most microcontrollers
- **Operating voltage:** 3.3 V – 5 V
- **1 mm JST-4 connector** compatible with STEMMA QT / Qwiic cables
- **Motor output pins:** OUT+ / OUT− for direct connection
- **Power indicator LED**
- **Compact PCB** with labeled pads for quick prototyping

Applications

- Smart wearables and fitness devices
- Handheld controllers and portable gaming systems
- Robotic grippers and interactive actuators
- Notification or feedback modules in IoT devices
- Haptic user interfaces and research platforms

Software Support

- **Arduino IDE**
- **Micro Python**

CONTENTS

1 The Board

1.1 Accessories

2 Ratings

2.1 Recommended Operating Conditions

Symbol	Description	Min	Typ	Max	Unit
VDD	Operating supply voltage	-	3.3	5.5	V
T_A	Operating free-air temperature	-40	-	85	°C
f_{PWM}	PWM input frequency (IN/TRIG Pin)	10	-	250	kHz
Z_L	Load impedance (VDD = 5.2 V)	8	-		Ω
V_{IL}	Digital low-level input voltage (EN, IN/TRIG, SDA, SCL)	-	-	0.5	v
V_{IH}	Digital high-level input voltage (EN, IN/TRIG, SDA, SCL)	1.3	-	-	v
f_{LRA}	Input voltage (analog mode, IN/TRIG)	125		300	Hz

3 Functional Overview

The **DevLab DRV2605L Haptic Motor Controller Module** is a compact, high-precision device designed to provide advanced vibration and tactile feedback control in embedded applications. At the heart of the module is the **DRV2605L** haptic driver from Texas Instruments, a fully integrated, closed-loop actuator driver capable of driving both Eccentric Rotating Mass (ERM) and Linear Resonance Actuator (LRA) motors with consistent amplitude, optimized efficiency, and minimal host intervention.

The **DRV2605L** operates as a complete haptic control subsystem, incorporating a digital waveform synthesizer, motor control amplifier, and automatic actuator calibration logic. Through a standard I²C interface, the host controller can configure operational parameters, select haptic effects from an internal library, or trigger custom waveforms stored in memory. This digital control structure eliminates the need for complex PWM generation or analog signal conditioning on the host microcontroller.

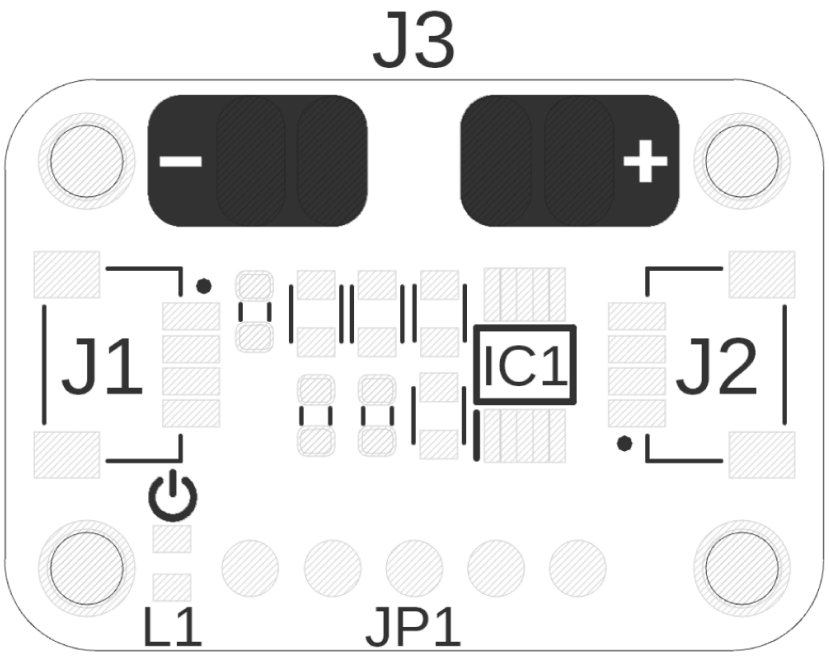
Internally, the device includes a waveform sequencer capable of chaining multiple predefined effects, enabling the creation of sophisticated tactile patterns such as multi-pulse clicks, ramped vibrations, or simulated textures. More than 100 waveform effects are stored in non-volatile memory, including tactile profiles optimized for both ERM and LRA actuators. Additionally, a real-time playback mode allows direct amplitude modulation in response to system events, sensor inputs, or audio data, enabling dynamic haptic synchronization with external signals.

A key functional block within the **DRV2605L** is the Auto-Resonance Calibration (ARC) engine, which continuously measures the mechanical characteristics of the attached actuator and adjusts the drive waveform accordingly. This feature compensates for changes in load, supply voltage, and environmental conditions, maintaining constant vibration strength and frequency response without user calibration. The result is stable, repeatable tactile output across variations in temperature, battery level, or actuator tolerances. The module is electrically compatible with 3.3 V to 5 V logic systems, allowing direct connection to common development platforms such as Arduino, ESP32, Raspberry Pi, and other single-board computers.

Its hardware interface is exposed through a 1.0 mm pitch 4-pin JST-SH connector, compliant with STEMMA QT / Qwiic standards, simplifying prototyping and daisy-chain connectivity for multi-sensor or multi-actuator systems. The motor output stage provides differential OUT+ and OUT− terminals, capable of directly driving vibration motors up to the rated load current of the driver.

The DevLab form factor ensures mechanical and electrical compatibility across all DevLab modules, promoting standardization and interoperability between haptic, sensor, and control peripherals.

3.2 Board Topology



Top View of Board Topology

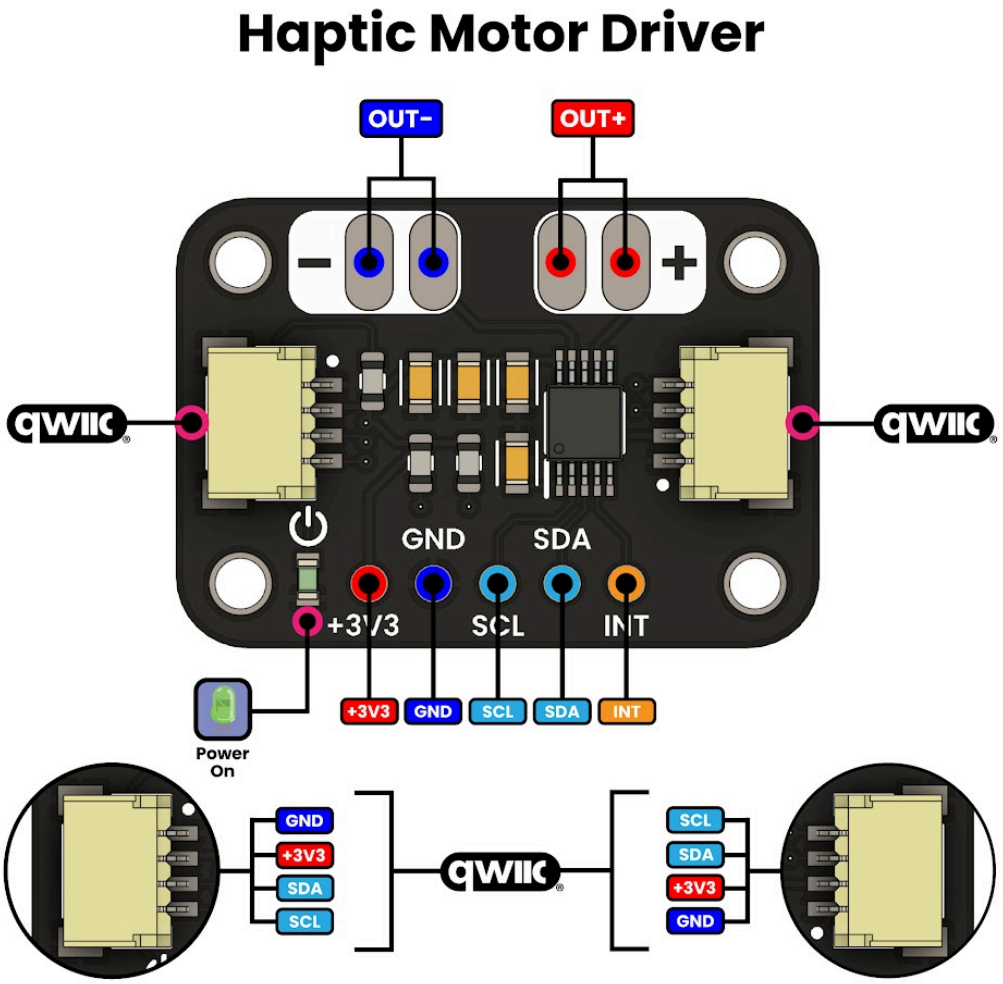
Views of DRV2605L Haptic Motor Controller Module Topology

Table 3.2.1 - Components Overview

Ref.	Description
IC1	DRV2605 Haptic Motor Driver
L1	Power On LED
J1	1mm JST Connector compatible with QWIIC and STEMMA QT Connector
J2	1mm JST Connector compatible with QWIIC and STEMMA QT Connector Jack
J3	Output for haptic motor
JP1	Header for Input Signals

4 Connectors & Pinouts

4.1 General Pinout



DevLab DRV2605L Haptic Motor Controller Module *General Pinout*

4.2 Pinout General Description

Pin Label	Function	Notes
+3V3	Power Supply	3.3V Power Supply
GND	Ground	Common ground reference
SCL	I2C SCL	Serial Clock Line
SDA	I2C SDA	Serial Data Line
INT	Power Supply	GPIO
OUT-	Motor -	Motor negative output
OUT+	Motor +	Motor positive output

5 Board Operation

5.1 Getting Started with MicroPython

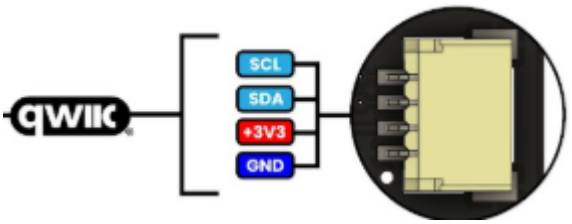
This example demonstrates how to control the **DRV2605L Haptic Motor Driver** using a MicroPython-compatible development board (e.g., ESP32, RP2040 Pico). The script initializes the DRV2605L through the I²C interface, configures the control and feedback registers, and plays a sample haptic effect sequence from the internal waveform library.

The official example is available in the UNIT Electronics GitHub repository:

https://github.com/UNIT-Electronics-MX/unit_i2c_drv2605l_haptic_motor_controller_module/blob/main/software/examples/python/main.py

Requirements

- MicroPython-capable board (ESP32, ESP32-C6, RP2040 Pico, etc.)
- DRV2605L module connected via I²C (7-bit address 0x5A)
- ERM or LRA vibration motor
- MicroPython firmware and REPL tool (e.g., Thonny or ampy)



DRV2605L Pin	MicroPython Board Pin	Description
VCC	3.3 V / 5 V	Power supply input
GND	GND	Ground reference
SDA	I²C SDA (e.g., GPIO 12 on RP2040)	Data line
SCL	I²C SCL (e.g., GPIO 13 on RP2040)	Clock line

1. Adjust SDA/SCL pins to your specific board (e.g., GPIO 21/22 on ESP32).
2. Example Overview
3. Initializes the DRV2605L in internal trigger mode.
4. Configures feedback for ERM operation (by default).
5. Selects the ERM library (Library ID = 1).
6. Sets a two-step “ramp” vibration sequence and activates it for ≈ 1 second.
7. The full implementation can be found in the linked repository above.

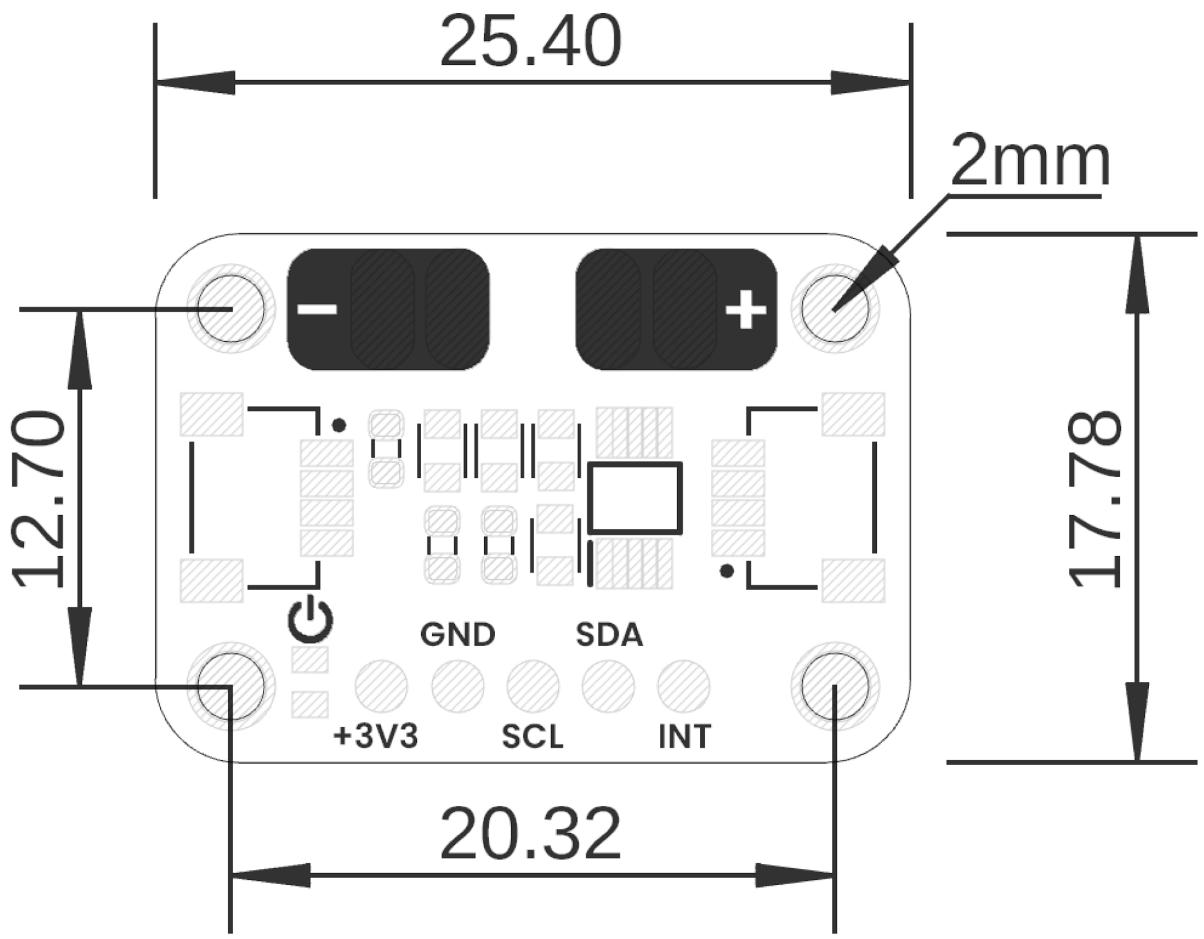
Additional Notes

Default I²C address: 0x5A
Supply Voltage: 3.3 V – 5 V
Supports ERM and LRA actuators (selectable via register 0x1A bit 7)
Fully compatible with the DevLab I²C form factor (Qwiic / STEMMA standard)

<untitled> *

```
        self.i2c.writeto_mem(self.address, reg, bytearray([value]))

    def read_register(self, reg):
        return self.i2c.readfrom_mem(self.address, reg, 1)[0]

# Initialize I2C
i2c = I2C(0, scl=Pin(13), sda=Pin(12))  # Use appropriate pins for your board, e.g. RP2040 (Pico)
drv = DRV2605L(i2c)

# Example usage
print("Initializing DRV2605L...")
drv.set_voltage(0x80, 0x90)  # Set voltage for 3.3V operation
drv.select_library(1)        # Use ERM library

# Example: Ramp Effect
print("Playing ramp effect...")
drv.set_waveform(0, 47)  # Increment effect
drv.set_waveform(1, 48)  # Decrement effect
drv.set_waveform(2, 0)   # End sequence
drv.go()
time.sleep(1)  # Vibrates for 1 second
drv.stop()
print("Ramp effect completed.")
```

6 Mechanical Information



Board Dimensions in Millimeters

Mechanical dimensions in millimeters

7 Company Information

Company name	UNIT Electronics
Company website	https://uelectronics.com/
Company Address	Salvador 19, Cuauhtémoc, 06000 Mexico City, CDMX

8 Reference Documentation

Ref	**Link**
Documentation	https://github.com/UNIT-Electronics-MX/unit_i2c_drv2605l_haptic_motor_controller_module
Getting Started Guide	https://unit-electronics-mx.github.io/unit_i2c_drv2605l_haptic_motor_controller_module/introduction.html
Thonny IDE	https://thonny.org/
Arduino IDE	https://www.arduino.cc/en/software
Visual Studio Code	https://code.visualstudio.com/download

9 Appendix

9.1 Schematic (*https://github.com/UNIT-Electronics-MX/unit_i2c_drv2605l_haptic_motor_controller_module/blob/main/hardware/unit_sch_v_1_0_ue0065_DRV2605.pdf*)

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