demo

1. Features

- RP2040 microcontroller for processing and USB communication
- MAX30102 heart rate and SpO2 sensor
- USB Type-C connector for power and data
- 3.3V voltage regulation using RT9013
- I2C communication interface
- Boot button using KMR211NGLFS switch
- Single power supply operation from USB (5V)

2. Applications

- Heart rate monitoring devices
- Wearable health monitoring systems
- SpO2 measurement applications
- Prototyping and development of health monitoring solutions

3. Description

The demo board is a compact PCB designed for heart rate monitoring applications. It features an RP2040 microcontroller interfaced with a MAX30102 heart rate sensor over I2C, powered by a USB Type-C connection with 3.3V voltage regulation.

4. Contents

5. Revisions

1.0.0 - 2024/03/16

5.1. Specifications

5.1.1. Pin Configuration and Functions

The board uses the following key interfaces:

- USB Type-C for power input and USB 2.0 communication
- I2C interface between RP2040 and MAX30102 sensor
- Boot button for RP2040 programming mode

5.1.2. Absolute Maximum Ratings

- Input Voltage (USB): 5V
- Operating Voltage: 3.3V
- Maximum Current Draw: Limited by USB specification (500mA)
- Operating Temperature: Based on component specifications
  - RP2040: -40°C to +85°C
  - MAX30102: -40°C to +85°C

5.2. Detailed Description

5.2.1. Overview

The demo board is a heart rate monitoring solution that combines the powerful RP2040 microcontroller with the MAX30102 sensor. The design uses a USB Type-C connector for both power and data communication, with the RT9013 regulator providing stable 3.3V power to the system. The MAX30102 sensor communicates with the RP2040 via I2C, enabling accurate heart rate and SpO2 measurements.

5.2.2. Functional Block Diagram

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graph TD
    USB[USB Type-C Connector] -->|5V| REG[RT9013 Regulator]
    USB -->|USB Data| MCU[RP2040 Microcontroller]
    REG -->|3.3V| MCU
    REG -->|3.3V| SENSOR[MAX30102 Sensor]
    MCU <-->|I2C| SENSOR
    BTN[Boot Button] --> MCU
```

5.3. Application and Implementation

5.3.1. Application Information

The demo board is designed for easy integration into heart rate monitoring applications. The RP2040 microcontroller can be programmed using standard USB protocols, and the MAX30102 sensor provides accurate heart rate and SpO2 measurements through the I2C interface.

5.3.2. Typical Applications

1. Heart Rate Monitoring Devices

2. Wearable Health Trackers
3. Medical Prototyping
4. SpO2 Measurement Systems

5.3.3. Design Requirements

- USB power supply (5V)
- Proper PCB layout for the MAX30102 sensor placement
- Adequate decoupling capacitors for stable operation
- Proper I2C routing between RP2040 and MAX30102

5.3.4. Power Supply Recommendations

The board is powered through the USB Type-C connector, which provides 5V. The RT9013 regulator converts this to a stable 3.3V supply for the RP2040 and MAX30102 sensor. Proper decoupling capacitors should be used on both voltage rails.

5.3.5. PCB Layout

Key considerations for PCB layout:

1. Short traces for I2C signals
2. Proper ground plane design
3. Adequate thermal design for the voltage regulator
4. Careful placement of the MAX30102 sensor for optimal performance
5. USB differential pair routing according to USB specifications

5.3.6. Device and Documentation Support

The design is supported by:

- RP2040 datasheet and documentation
- MAX30102 sensor documentation
- RT9013 regulator documentation
- USB Type-C connector specifications

5.3.6 Indexing

5.3.6 Figures

5.3.6 Tables