RT1025 ECG/PPG AFE Daughter Board

Purpose

The RT1025 is an integrated SOC solution for Heart-Rate monitoring and Biopotential measurements. The RT1025 integrate low noise voltage and current sensing channels and is capable of sensing ECG(Electrocardiography) and PPG(Photoplethysmography) simultaneously. Richtek Technology develops a daughter board (DTB) to evaluate RT1025 performance. This document describes the operation manual of RT1025 daughter board. It includes the schematic, hardware and bench measure procedure.

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Introduction

General Product Information

The RT1025 is an integrated AFE solution for Heart-Rate monitoring and measurements. The RT1025 integrates low noise voltage and current sensing channels and is capable of sensing ECG (Electrocardiography) and PPG (Photoplethysmography) simultaneously. The RT1025 have > 100dB dynamic range and can sense pulses accurately by detecting the heart's electric signals. The sampling rates of the high-precision voltage and current sensing channels in the RT1025 are configurable between 64 to 4 kHz. The RT1025 solution need only few discrete components and is easy to use for low-power medical ECG/PPG, sports, and fitness applications. With high levels of integration and high-precision voltage and current sensing channels, the RT1025 solution is suitable for scalable medical instrumentation systems. The RT1025 is available in a 3.1mm x 3.4mm, 41-Ball, 0.4mm pitch, WL-CSP package.

The daughter board (DTB) was developed to bring out alls of RT1025 pins to DIP pins. The daughter board includes the RT1025 together with the required 32kHz Xtal and the passive components to quickly evaluate the operation and performance of the RT1025. The detail schematic, hardware and bench measure procedure will be described in the following section. The daughter board number is PCB107_V1 and the dimensions are 3.3cm x 3.3cm.

Product Feature

- **Daughter Board Feature**
  - **Evaluation Board Number : PCB107_V1**
  - **Dimension : 3.3cm x 3.3cm**
  - **32 DIP Pins**
- **ECG Channel Feature**
  - **Supports Two-Electrode (2E) Mode and Right Leg Drive (RLD) Mode**
  - **Low Noise PGA and High Resolution ADC**
  - **Input Impedance : 125M to 500MΩ at Two-Electrode Mode and > 1GΩ at Right Leg Drive Mode**
  - **Low Input-Referred Noise : 0.67μVrms (64Hz ODR, Gain = 12)**
  - **Dynamic Range : 110dB at Gain = 6**
  - **CMRR > 85dB at 60Hz**
  - **Data Rate : 64SPS to 4k SPS**
- **PPG Channel Feature**
  - **Flexible Timing Control and Support Dynamic Power Down**
  - **TX Supports H-bridge and Push/Pull Mode**
  - **TX LED Current Range : 10 / 25 / 35 / 50 / 65 / 75 / 90 / 105mA, Each with 8-bit Current Resolution**
  - **Input Maximum Current Range : 0.5 to 50μA**
  - **Input Maximum Capacitance : 1nF**
  - **Input-Referred Noise : 50pA$_{rms}$ at 5μA Input Current**
  - **CMRR > 80dB at 60Hz**
  - **PGA Gain : 1 to 6V/V**
  - **Ambient DAC1/DAC2 Range : 1 to 6μA**
- **Others**
  - **2-in-1 Bio-Sensing AFE (Voltage/Current)**
  - **Built-In Heartbeat Interval Estimation**
  - **Integrates an Oscillator to offer High-Precision Clock with External Crystal**
  - **Support I^{2}C and SPI I/F for MCU**
  - **On-Chip SRAM for Data Buffering**

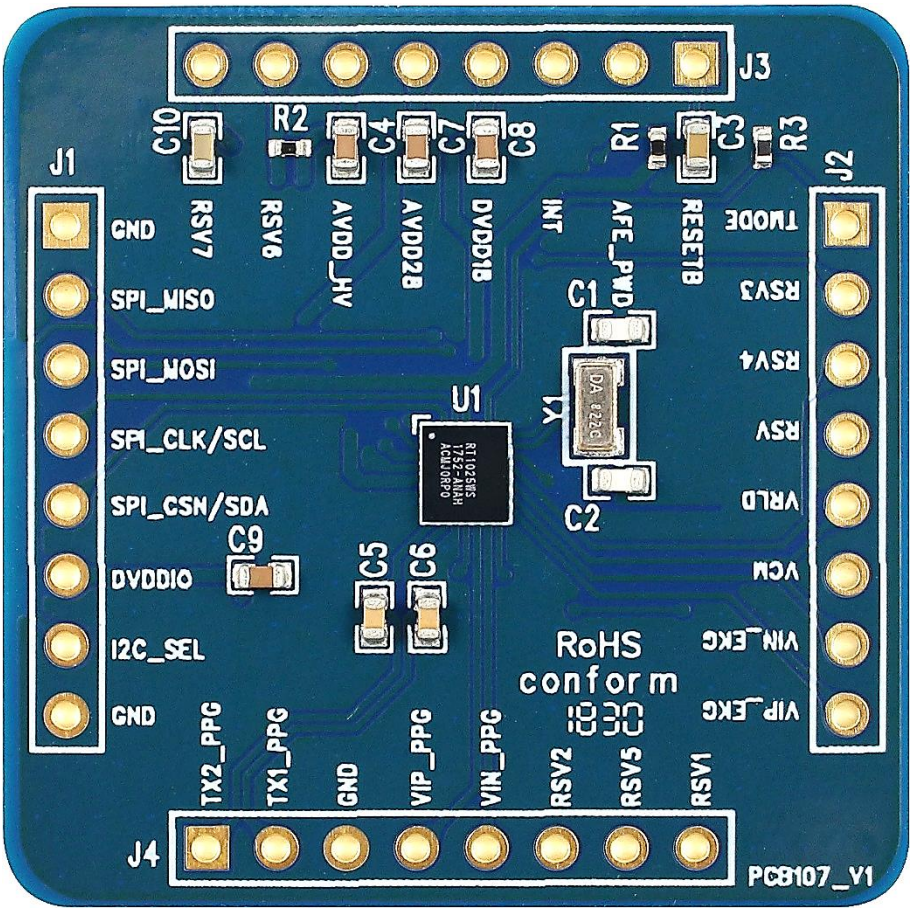
- **Ultra-Low Power Consumption**
- **Operating Temperature Range : –20°C to 65°C**
- **Small 3.1mm x 3.4mm, 41-Ball, 0.4mm Pitch, and WL-CSP Package**
- **RoHS Compliant and Halogen Free**

Key Performance Summary Table

Key Features	Evaluation Board Number : PCB107_V1
Analog Supply Voltage	2.8V
Digital Supply Voltage	1.8V
I/O Supply Voltage	1.8V to 3.3V
Current Consumption (Idle)	< 7μA
Current Consumption (ECG)	570μA
Current Consumption (PPG)	530μA
Default Marking & Package Type	RT1025WS, WL-CSP-41B 3.10x3.48 (BS)

Bench Test Setup Conditions

Headers Description and Placement



Carefully inspect all the components used in the EVB according to the following Bill of Materials table, and then make sure all the components are undamaged and correctly installed. If there is any missing or damaged component, which may occur during transportation, please contact our distributors or e-mail us at evb_service@richtek.com.

Test Points

The EVB is provided with the connecter interfaces and pin names listed in the table below.

Test Point	Pin Name	Comment (expected waveforms or voltage levels on test points)
JP1-1	GND	Ground.
JP1-2	SPI_MISO	SPI serial out master in.
JP1-3	SPI_MOSI	SPI serial in master out.
JP1-4	SPI_CLK / SCL	1. SPI mode : SPI clock pin. (SPI_CLK) 2. I^2C mode : I^2C clock pin. (I2C_SCL)
JP1-5	SPI_CSN / SDA	1. SPI mode : SPI data pin. (SPI_CSN) 2. I^2C mode : I^2C data pin. (I2C_SDA)
JP1-6	DVDDIO	Digital IO supply.
JP1-7	I2C_SEL	1. SPI mode : please keep I2C_SEL low. 2. I^2C mode : please keep I2C_SEL high.

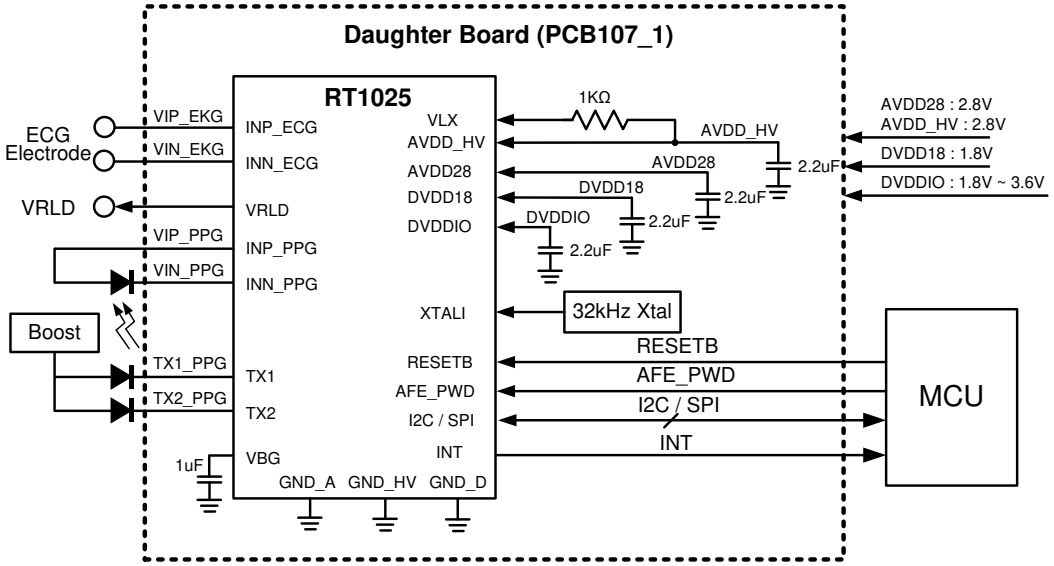
Test Point	Pin Name	Comment (expected waveforms or voltage levels on test points)
JP1-8	GND	Ground.
JP2-1	TMODE	Leave floating. (Connect to Ground on EVB)
JP2-2, JP2-3, JP2-4	RSV3, RSV4, RSV	Reserve for testing. (Leave floating)
JP2-5	VRLD	RLD output. (Leave floating at 2E mode)
JP2-6	VCM	PPG input common mode voltage. (Leave floating)
JP2-7	VIN_EKG	INN_ECG Pin for ECG IA negative input.
JP2-8	VIP_EKG	INP_ECG Pin for ECG IA positive input.
JP3-1	RESETB	Reset pin.
JP3-2	AFE_PWD	Power down pin.
JP3-3	INT	Interrupt pin.
JP3-4	DVDD18	Digital supply.
JP3-5	AVDD28	Analog supply.
JP3-6	AVDD_HV	PPG LED driver power.
JP3-7, JP3-8	RSV6, RSV7	Reserve for testing. (leave floating)
JP4-1	TX2_PPG	TX2 pin for LED driver output.
JP4-2	TX1_PPG	TX1 pin for LED driver output.
JP4-3	GND	Ground.
JP4-4	VIP_PPG	INP_PPG Pin for PPG receiver input pin.
JP4-5	VIN_PPG	INN_PPG Pin for PPG receiver input pin.
JP4-6, JP4-7, JP4-8	RSV2, RSV5, RSV1	Reserve for testing. (Leave floating)

Measurement Procedure

The RT1025 daughter board is fully assembled and tested. The daughter board brings out all I/O pins of the RT1025 for easily evaluate the IC performance and development.

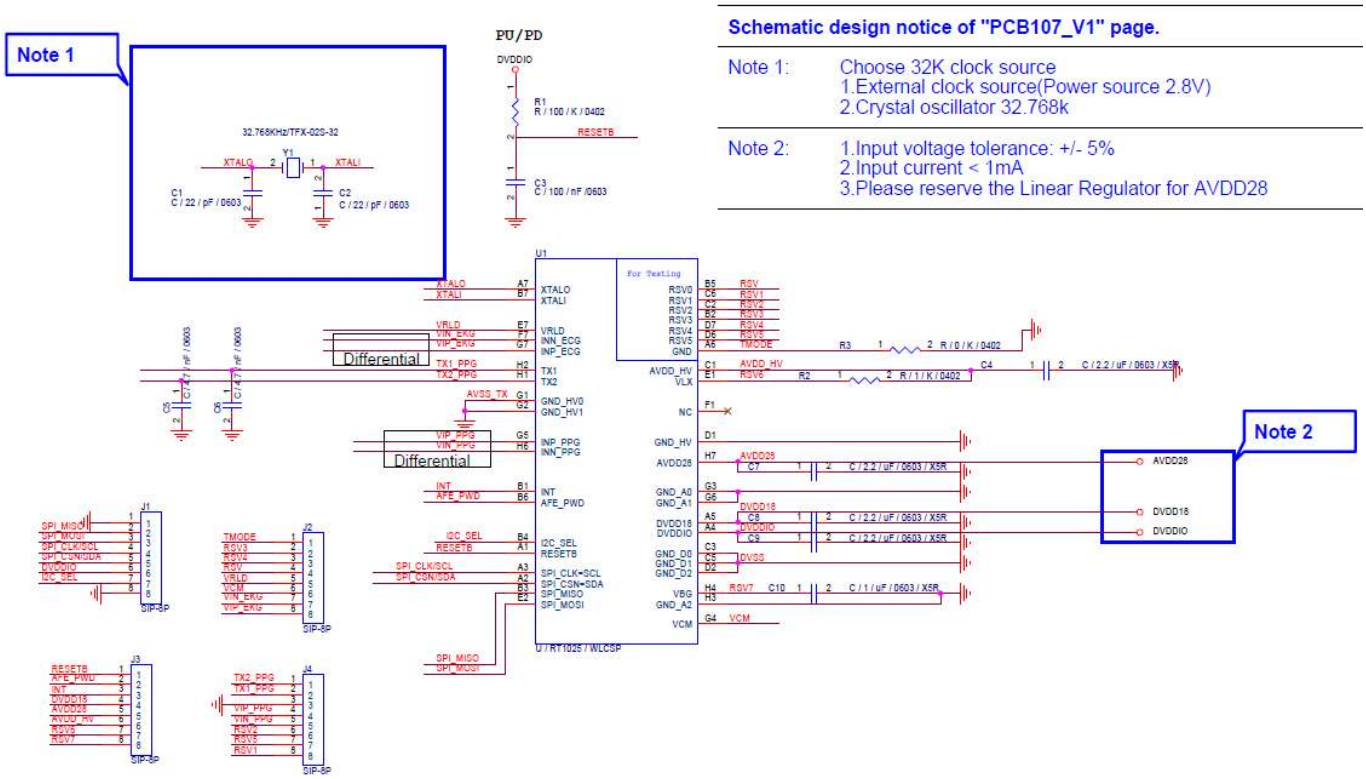
Typical Applicatin Circuite

Using daughter board for ECG/PPG Sensing



Schematic, Bill of Materials & Board Layout

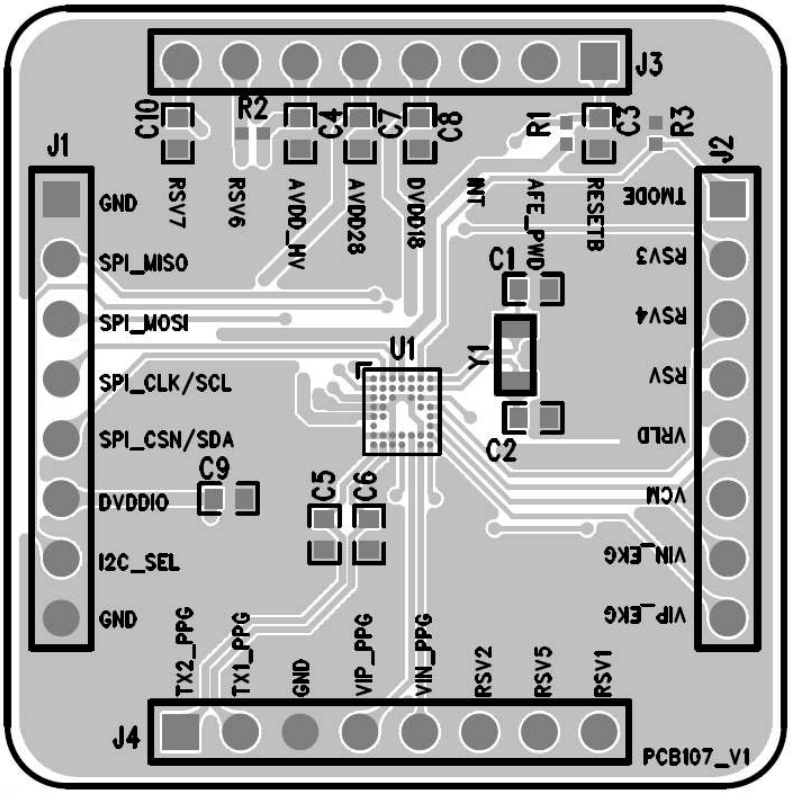
EVB Schematic Diagram



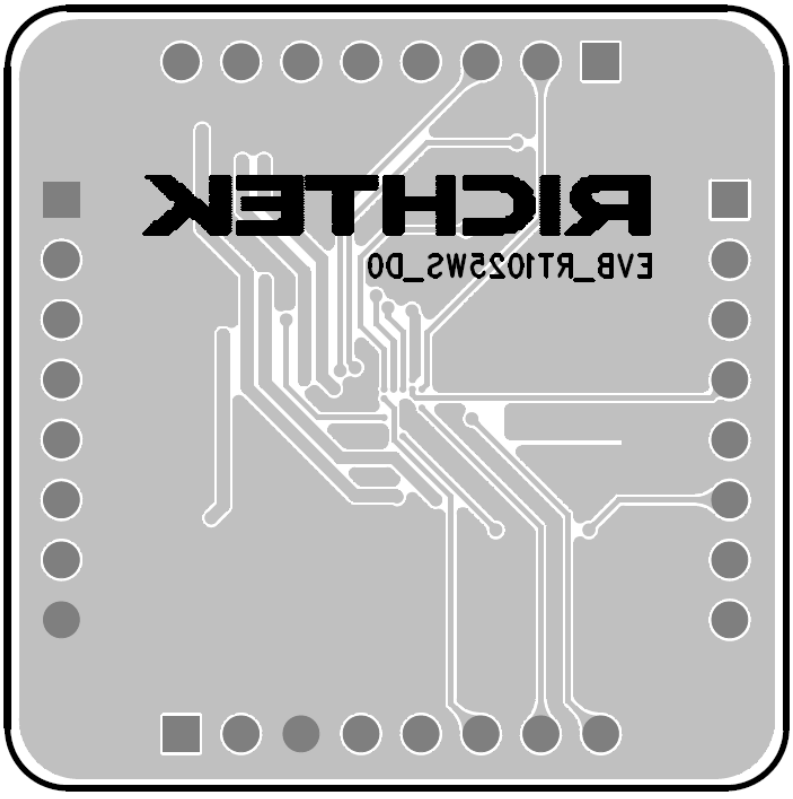
Bill of Materials

Reference	Qty	Part Number	Description	Package	Manufacturer
C1, C2	2	0603N220J500CT	22pF/50V/NPO	C-0603	WALSIN
C3	1	C1608X7R1H104K080AA	100nF/50V/X7R	C-0603	TDK
C4, C7, C8, C9	4	0603X225K160CT	2.2µF/16V/X5R	C-0603	WALSIN
C5, C6	2	0603B472K500CT	4.7nF/50V/X7R	C-0603	WALSIN
C10	1	C1608X5R1E105K080AC	1µF/25V/X5R	C-0603	TDK
R1	1	WR04X1003FTL	100k/1%	R-0402	WALSIN
R2	1	WR04X1001FTL	1k/1%	R-0402	WALSIN
R3	1	WR04X000 PTL	0k	R-0402	WALSIN
U1	1	RT1025WS	ECG/PPG AFE IC	WL-CSP-41B 3.10x3.48 (BS)	Richtek
Y1	1	DST-310S	32.768kHz/TFX-02S-32	CRY-DST310S	HARMONY

PCB Layout



Top View



Bottom View

More Information

For more information, please find the related datasheet or application notes from Richtek website http://www.richtek.com.

Important Notice for Richtek Evaluation Board