RENESAS
BIG IDEAS FOR EVERY SPACE

GALVANIC SKIN RESISTANCE AND BODY COMPOSITION METER SOLUTION
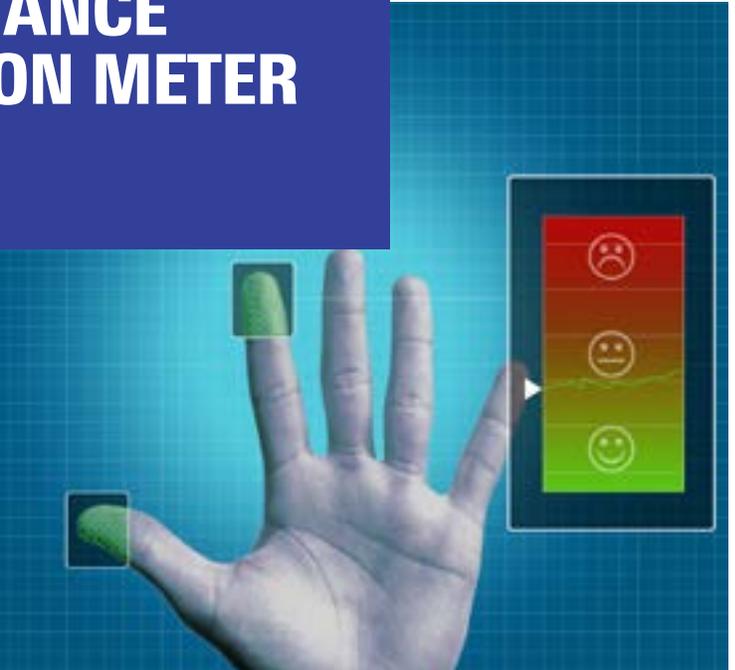
Galvanic Skin Resistance (GSR) and Body Composition (BCM) measurements provide valuable biometric information that can be used in inferring emotional state and calculating body fat mass, respectively. Renesas has developed a reference design/solution that can be used by our customers as a starting point for wearable galvanic skin response products and hand held body composition meter systems. This battery-powered device takes DC conductance measurements in GSR mode and high-precision AC impedance measurements in BCM mode, while consuming minimal power.

The resolution and the speed of the Analog-to-Digital Converters is critical for the accuracy of GSR-BCM measurements along with skin temperature compensation. Given that these measurements are mostly used in portable or wearable products, they offer energy efficiency and wireless connectivity. The GSR-BCM solution leverages the Renesas Synergy™ S1JA MCU for its high-performance analog and low power capabilities. It also highlights the RL78/G1D for Bluetooth connectivity and the ISL9203A for Li-Ion battery charging.

GSR-BCM Solution with Electrodes

Biosensing GSR/BCM Reference Design
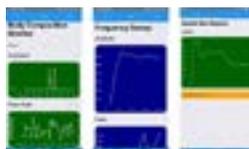
Mobile Apps Screen

Solution Highlights

- GSR Mode
    - Skin conductance as a function of time
    - Infer stress condition
- BCM Mode
    - Body impedance (magnitude & phase) as a function of time, or frequency sweep
    - Body Fat Mass
    - Body Mass Index
- Measures body temperature
- Mobile access via iOS and Android apps

RENESAS RL78   Renesas Synergy™

GSR-BCM Module Block Diagram

GSR Electrode

BCM Electrode

GSR Interface

BCM Interface

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Renesas Synergy™ S1JA
MCU

RL78
RL78/G1D BLE Module

TEMP SENSOR

USB Micro B Interface

RENESAS
ISL9203A Battery Charger IC

Power Management

Battery
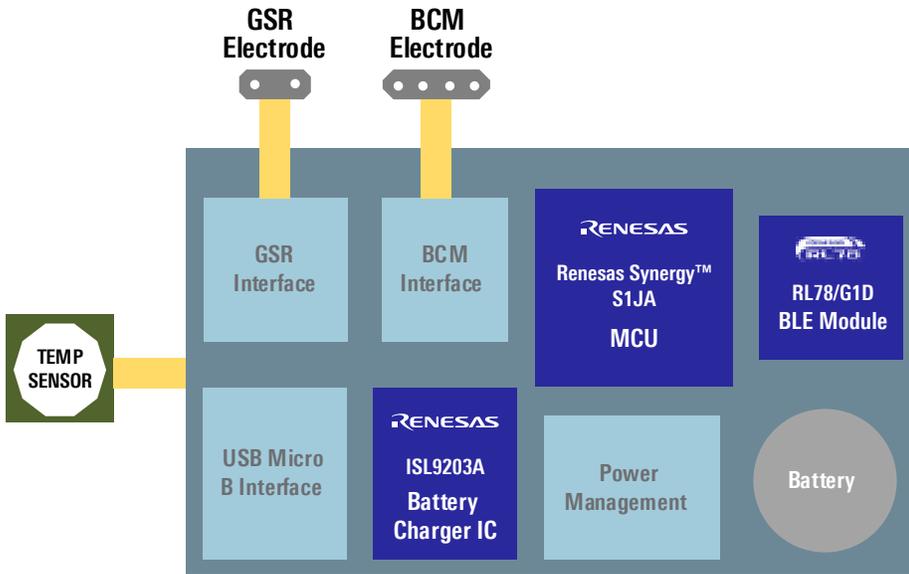
Features

- Small Form Factor
- Fuel Gauge
- USB Charging
- Bluetooth Low Energy (BLE)
- Temperature Sensor
- DC Conductance Measurements in GSR Mode
- High-precision AC Impedance Measurements in BCM Mode
- Power Switch and LED

Once the device is switched on, the GSR-BCM solution can be selected from the list of Bluetooth supported devices on the mobile app. The GSR measurement page is shown first as soon as the communication is established. Two Velcro covered electrodes are used to collect the GSR data. The DC conductance values are displayed on a time-chart diagram in GSR mode. The Emotion State Curve of a person can be visualized using this data. BCM mode can be selected by swiping the screen sideways or selecting the BCM tab on the top of the mobile app screen. A typical hand electrode is used to collect the BCM data. The frequency sweep measurement plots the body impedance and phase shift caused by the cell capacitance. Another chart displays the measured impedance and phase shift over time for a particular frequency. The specific frequency is selected using the drop-down control above the chart.

An independent temperature sensor enclosed within the finger cuff is used to measure the real-time body temperature which is displayed on both GSR & BCM tabs. The user can enter the weight, height, gender and age to calculate the Body Mass Index (BMI) and Body Fat Percentage using the measured BCM data in a separate tab on the mobile app.

The GSR-BCM solution is based on the Renesas Synergy™ S1JA MCU and the RL78/G1D MCU. The Synergy S1JA MCU features built-in AFE with operational amplifiers, ADCs, DACs and high-speed comparators. In addition to the analog components, S1JA includes all traditional MCU interfaces driven by an energy efficient Arm Cortex-M23 32-bit core. The RL78/G1D is an industry-leading, low-power Bluetooth Smart v4.2 MCU. The reference solution also features the ISL9203A, a Renesas Battery Charger IC that controls the charge current as a function of the battery voltage.

Learn more about our Healthcare Solutions:
www.renesas.com/en-us/solutions/home/healthcare.html

Learn more about our GSR-BCM Solutions:
https://www.renesas.com/gsr-bcm-biosensing-solution

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