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MUSEIC V3

MUSEIC V3: an all-in-one chip solution for battery-powered wireless healthcare applications

PROPOSITION

MUSEIC V3 is a single-chip SoC ideally suited for battery-powered wireless healthcare applications. It offers a wide range of on-chip bio-medical sensor readouts: ECG, Bio-Impedance (BIO-Z) and Photoplethysmography (PPG). These on-chip sensor readouts enable an accurate, reliable and broad health and vital sign assessment particularly tailored for wearable systems. Each of these sensor readouts is custom designed and optimally custom made for reliable operation at ultra-low-power consumption with features that improve the signal quality in real-time, such as efficient digital filters to reduce noise, and ambient light cancelation for PPG. In addition generic interfaces allow to collect data from external sensors like IMUs and temperature sensors for example.

A Cortex ARM M4f processor with 192kB SRAM, supported by powerful accelerators (FFT, matrix processor, sample-rate-converter, and DMA) enables low-power digital signal processing like beat analysis, artefact removal, feature extraction, and more. The sample-rate converter makes the sample-rates of data from internal and external sensor readouts compatible with each other, enabling advanced sensor fusion algorithms. The FFT and matrix processor efficiently performs many operations typically used by sensor applications, off-loading the processor. Embedded non-volatile memory

(384kB eFlash) is available for your custom embedded firmware and sensor data storage. MUSEIC V3 implements various security features like data encryption, secure boot and secure authentication, which are increasingly important in medical and healthcare applications. MUSEIC V3 supports a range of standard user interfaces including SPI, I2C, GPIO, and USB2.0. A fully integrated Bluetooth Low Energy (BLE 4.2) radio provides wireless connectivity. Power management can power the whole chip from a single power source between 0.8V and 5V. The PMU features a 5V LDO, and a single-inductor, multiple output (SIMO) boost converter for the various supply domains while a ripple free linear regulator is used for the sensitive analog readouts. The modular approach of the MUSEIC V3 SoC allows for customization towards specific applications: the customer can configure the MUSEIC V3 SoC according to system requirements. MUSEIC V3 is a very complete SoC that covers the full range from data collection, data processing, up to secured (wired/wireless) data communication.

APPLICATION FIELDS

- Medical application with the need for ECG, PPG, Bio-Z, EEG
- Multi-sensor based (including external readouts to enable various applications)
  - Sleep monitoring
  - Energy expenditure
  - Wrist motion tracking
- Corporate health and wellness
- Vital-sign collection during clinical trials
- Fitness and sports applications

KEY FEATURES

- Versatile multi-sensor signal acquisition platform

- ECG readouts (2 channels)

  - Gain: 20V/V - 160V/V ; Noise: $1.2\mu V_{RMS}$ RTI (0.5Hz-150Hz) ; SAR-ADC: 13b@32kHz

  - Lead-on/off detection

  - Fast settling DC-offset removal

  - Driven-right-leg for improved CMRR

- Multi frequency bio-impedance readout

  - Resolution: $<20m\Omega_{RMS}$ (BW:0.1-4Hz, R<2kΩ); SAR ADC: 13b@128kHz

  - Wide input range ($<120mV_{PK}$) enabling 2 electrodes measurement

  - Lead-on/off detection.

  - Low noise current injection: 1kHz – 1 MHz; 5 - 100 μA_{PK}

  - Multi-frequency and -channel controller for up to 32 bio-impedance read-outs

  - In-phase and quadrature phase signal components

- Photo-plethysmograph (PPG) readout

  - Sensitivity: $<2 nA_{PK}$; Noise: $< 200pA_{RMS}$ (1-64Hz)

  - Dynamic range: 75 μA;

  - Automatic ambient cancelation: 50 μA (max)

  - Four LED drivers supporting up to 160mA each

- CMRR: > 100dB for all readouts

- Processor core

  - ARM Cortex M4 processor with floating point processor support

  - JTAG debug

  - 384kB on-chip FLASH, 192kB on-chip SRAM, 32kB bootloader ROM

  - Operation clock frequency: 1MHz ... 80MHz

- ARM Cordio BT4 radio

- Security

  - Secured-boot, Data encryption and Authentication

  - Crypto co-processor supporting: RSA/ECC/ECDSA/DSA (asymmetric operations), AES-GCM/CBC/CTR, SHA-1/SHA-2/ChaCha20/Poly1305 (symmetric operations)

  - Non deterministic random number generator

  - Key generation and storage using the digital fingerprint ('PUF') of a SRAM.

- Digital interfaces

  - SPI (4x), I2C master (4x), UART (2x)

  - Maximum of 32 GPIOs

  - USB 2.0 (device mode)

- Peripherals

  - DMA controller (8 channels)

  - Sample rate converter (up/down sampling)

  - Vector / Matrix calculator for many standard vector/matrix operations

  - FFT module (supported sizes: 8 ... 4096 samples)

- On-chip power management

  - Battery operated: 0.8V – 5V

  - SIMO Buck-boost converter: Single input (0.8V – 3.6V) ; 7 programable outputs (0.4V – 2.5V)

  - Two efficient, ripple free (programmable) linear regulators (0.8V – 1.2V)

  - One high voltage linear regulator (5V)

- Low power:

  - 400 μW @1.2V for ECG data collection

  - 150 μW @0.6V for ECG data collection

CUSTOMERS

- Medical device manufacturers

- Consumer electronics companies

- Wearable device manufacturers

- Health, wellness and sports technology startups

- OEM suppliers in health & wellness

- Semiconductor companies and foundries

KEY BENEFITS

- Highly integrated solution for multi-sensor data acquisition

- Supports a wide range of bio-medical sensors by means of dedicated low-noise low-power on-chip sensor readouts: ECG, BIOZ, PPG.

- Synchronized and sample-rate compatible data streams from a wide range of sensors allow accurate and reliable calculations

- Complete all-in-one chip solution including power-supplies and LED drivers

- Ultra low-power. High flexibility and configurability (supply voltage) enables to make the system power efficient for a wide range of applications

- Highly configurable