



## MUSEIC V2

### MUSEIC V2 IS A LOW-POWER MULTI (BIO-)SENSOR ACQUISITION IC PLATFORM FOR HEALTHCARE APPLICATION

#### PROPOSITION

MUSEIC V2 covers a wide range of on-chip bio-medical sensor readouts: ECG, Bio-Impedance (BIO-Z), Galvanic Skin Response (GSR), Photoplethysmography (PPG), EMG, and EEG. In addition, general purpose analog and digital interfaces allow to collect data from external analog or digital sensors.

These on-chip sensor readouts enable an accurate, reliable and broad health and vital sign assessment particularly tailored for wearable systems. Since the data is acquired on one chip, precise synchronization between the data streams is possible, allowing to perform correlation techniques between the data streams.

The readouts have features that improve the signal quality in real-time, such as automatic Motion Artefact Reduction for ECG, and ambient light cancelation for PPG.

A low-power Cortex ARM M0+ processor controls the data collection and makes use of powerful accelerators: configurable filters, a vector/matrix processor, and a sample-rate-converter. The sample-rate converter makes the sample-rates of data from internal and external sensor readouts compatible with each other, enabling to perform accurate and reliable calculations.

The platform consists of two chips: the readout system-on-chip (SOC) and a power management IC (PMIC). Besides powering the SOC and driving the LEDs for the PPG channel, the PMIC chip features two programmable voltage references (0.5V to 2V with 50mV step) to control the buck voltage regulators. A ripple free linear regulator is used for the sensitive analog readouts. All three regulators in the PMIC can be used for general purposes in low power applications.

The modular approach of the MUSEIC V2 IC platform allows for customization towards specific applications: the customer can configure the MUSEIC V2 IC platform according system requirements.

#### APPLICATION FIELDS

- ECG/PPG driven
  - Heart rate (HR), Heart-rate variability (HRV), cardiac rhythm analysis
  - Pulse-oximetry (SpO2)
  - Blood pressure (BP)
- GSR driven
  - Electrodermal activity (EDA) monitoring
  - Personalized stress assessment and management
- BIO-Z driven
  - Fat ratio, non-fat ratio
  - Fluid status (Congestive Heart Failure (CHF)
  - Respiration analysis (Obstructive Sleep Apnea (OSA), Chronic Obstructive Pulmonary Disorder (COPD))
  - Impedance tomography

- EEG driven
  - Neurological condition detection, epileptic seizure detection
- Multi-sensor based (including external readouts such as gyro and accelero)
  - Sleep monitoring
  - Energy expenditure
  - Wrist motion tracking
  - Attention monitoring
- Wearable technology, smart Watches, health patches
- Corporate health and wellness
- Vital-sign collection during clinical trials
- Fitness and sports applications

## KEY FEATURES

- Versatile multi-sensor signal acquisition platform
- ECG readouts (3 channels)
  - Gain: 24V/V - 880V/V ; Noise: <700nVrms RTI (0.5Hz-150Hz) ;  $\Sigma\Delta$ ADC: 18b (15b SNR)
  - Lead-on/off detection
  - Motion-artefact reduction
- Fixed frequency bio-impedance (BIO-Z) readout
  - Resolution: 3m $\Omega$ /sqrt(Hz);  $\Sigma\Delta$  ADC: 18b (15b SNR)
  - Current injection frequency: 20 or 40 kHz
- Multi frequency bio-impedance readout
  - Resolution: 0.1 $\Omega$ ; SAR ADC: 12b (10b SNR)
  - Current injection frequency: 1kHz – 1 MHz
- Reconfigurable readouts (3 channels)
  - Supports ECG, EEG, EMG, BIO-Z, and GSR
  - Compact readout with state-of-the-art performance
- Photo-plethysmograph (PPG) readout
  - Sensitivity: <10 nA; Noise: < 18pArms (1-64Hz)
  - Dynamic range: 10  $\mu$ A;
  - Automatic ambient cancelation: 10  $\mu$ A (max)
  - Supports 2 photo diodes
- Galvanic skin response (GSR) readout
  - Sensitivity: 0.5 nA; dynamic range: 1.8  $\mu$ A
  - Skin conductance range: 1.4nS ... 140  $\mu$ S

- Noise: <50 pArms; SAR ADC: 12b (10b SNR)
- CMRR: > 100 dB for all readouts
- Key digital interfaces and peripherals
  - SPI (5x), I2C-bus (3x), UART (2x); Up to 48 GPIOs
  - Data compactor for efficient sample storage
  - Sample rate converter
  - Vector/Matrix processor
  - PPG/LED controller for 4 LEDs and 2 photodiodes
  - Multi-frequency and -channel controller for up to 4 bio-impedance read-outs
- Single-battery operated (Lithium 2.9 – 4.5V)
- Programmable buck converters: 0.5V – 2V
- Low power:
  - 500  $\mu$ W @1.2V for ECG data collection
  - 200  $\mu$ W @0.6V for ECG data collection
- Dual chip: SOC for signal data acquisition and PMIC for power supplies and LED drivers

## 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, GSR, EEG, EMG
- Synchronized and sample-rate compatible data streams from a wide range of sensors allow accurate and reliable calculations
- Complete 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 at IP level to build dedicated MUSEIC readout systems

### AMERICAS

raffaella.borzi@imec.be  
T +1 408 386 8357

### JAPAN

isao.kawata@imec.be  
T +81 90 9367 8463

### CHINA

timo.dong@imec-cn.cn  
+86 13564515130

### TAIWAN & SE-ASIA

mavis.ho@imec.be  
T +886 989 837 678

### EUROPE & ISRAEL

michel.windal@imec.be  
+32 478 96 67 29

### VIETNAM, BRAZIL, RUSSIA, MID EAST, INDIA

max.mirgoli@imec.be  
T +1 415 480 4519

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