

## Ultra-Low-Power, Clinical-Grade Vital-Sign AFE

### General Description

The MAX86178 is a highly integrated, multiple vital-sign monitoring device with a complete photoplethysmogram (PPG), electrocardiogram (ECG) and biopotential (BioZ) analog front end (AFE) for wearable applications. The MAX86178 offers high performance for wellness and clinical applications with low power for long battery life.

The PPG data acquisition system supports up to 6 LEDs and 4 photodiode inputs. The LEDs are programmable from two high-current, 8-bit LED drivers. The receive path has two low-noise, high-resolution readout channels that each include independent 20-bit ADCs and industry-leading ambient light cancellation (ALC) circuits, producing the highest performing integrated optical data acquisition system on the market today.

The ECG channel has EMI filtering, internal lead biasing, right-leg drive, and extensive calibration voltages for built-in self-test. The ECG channel also has high-input impedance, low noise, high CMRR, programmable gain, an anti-aliasing low-pass filter, and a high-resolution ADC. It is designed to meet IEC 60601-2-47 Ambulatory ECG Systems monitoring compliance requirements.

The BioZ receive channel has EMI filtering and extensive calibration features. The BioZ receive channel also has high input impedance, low noise, programmable gain, low-pass and high-pass filter options, and a high-resolution ADC. There are several modes for generating input stimulus: balanced square-wave source/sink current, sine-wave current, and both sine-wave and square-wave voltage stimuli. A wide range of stimulus magnitudes and frequencies is available.

The MAX86178 has DC and AC lead-off detection, a flexible timing system, and a PLL. All three sensor channels are synchronized. The MAX86178 is available in a 7 x 7 49-bump wafer-level package (WLP) with package dimensions of 2.77mm x 2.57mm, and operates over -40°C to +85°C temperature range.

### Applications

- Wearable Vital-Sign Monitors
- Ambulatory Heart Rate Monitors
- Pulse-Oximetry Devices
- Smart-Clothing Applications
- Impedance Cardiography/Hemodynamic Monitors
- Single- and Multi-Frequency Bioimpedance Analysis
- Pulse Arrival Time (PAT), Pulse Transit Time (PTT), Pulse Wave Velocity (PWV) Assessments

### Benefits and Features

#### PPG

- Dual-Channel Optical Data-Acquisition System
- 113dB SpO<sub>2</sub> System SNR
- Excellent Ambient Range and Rejection Capability
  - > 200µA Ambient Photodetector Current
  - > 90dB Ambient Rejection at 120Hz with Averaging

#### ECG

- Clinical Grade ECG Acquisition System
  - 15.3 ENOB with 0.72µV<sub>RMS</sub> (0.05Hz to 40Hz)
  - 230fA<sub>RMS</sub> Input-Current Noise (0.05Hz to 40Hz, +25°C)
- Fully Differential Signal with CMRR > 110dB at 50Hz and 60Hz
- High Input Impedance > 1GΩ for Extremely Low Common-to-Differential Mode Conversion
- High DC-Differential Input Range of ±1000mV (typ 1.8V) Allows a Wide Variety of Electrodes to be Used
- High AC-Dynamic Range of 200mV<sub>P-P</sub> Prevents Saturation Due to Motion, or Varying Half-Cell Potentials

#### BIOZ

- High-Performance BioZ Data Acquisition System
- Low-Noise BioZ Receive Channel (17 ENOB, 0.16µV<sub>RMS</sub>)
- Sine-Wave, Square-Wave, Current and Voltage Stimulus (16Hz to 500kHz)
- BIA/BIS Measurement with High Absolute Resistance and Reactance Accuracy

#### SYSTEM

- Ultra-Low-Power Systems for Wearable Devices
- DC and AC Lead-Off Detect Capability
- Shutdown Current of 0.5µA (typ)
- 256-Word FIFO for ECG, PPG, and BioZ
- Flexible Interrupt and Multi-AFE Synchronization
- FIFO Timing Data Allows Synchronized PPG, ECG, and BioZ

Visit [Web Support](#) to complete the nondisclosure agreement (NDA) required to receive additional product information.

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**TECHNICAL SUPPORT**

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