

## Ultra-Low-Power, Optical PPG and Single-Lead ECG AFE

### General Description

The MAX86176 is a complete photoplethysmogram (PPG) and electrocardiogram (ECG) analog front-end (AFE) solution for wearable applications. The MAX30005 is a complete AFE solution for ECG only. Both AFEs offer high performance for fitness and clinical applications with ultra-low power for long battery life.

Both MAX86176 and MAX30005 feature an ECG channel, EMI filtering, internal-lead biasing, AC and DC lead-off detection, right-leg drive, ultra-low power DC lead-on detection during standby mode, and extensive calibration voltages for built in self-test. In addition, the MAX86176 has a PPG data acquisition system supporting up to 6 LEDs and 4 photodiode inputs, which is fully synchronized with the ECG signal path. The MAX86176/MAX30005 can operate with either internal or external clock. The MAX86176/MAX30005 are designed to meet IEC 60601-2-47 Ambulatory ECG Systems monitoring compliance for even the most challenging dry electrode applications.

The MAX86176/MAX30005 are available in a 6x6 36-bump wafer-level packages (WLP), operating over the -40°C to +85°C temperature range.

### Applications

#### PPG (MAX86176)

- Wearable Devices for Fitness, Wellness and Medical Applications with Clinical Accuracy
- Suitable for Wrist, Finger, Ear and Other Locations
- Optimized Performance to Detect Heart Rate, Oxygen Saturation (SpO<sub>2</sub>), Muscle and Tissue Oxygen Saturation (SmO<sub>2</sub> and StO<sub>2</sub>), and Body Hydration

#### ECG (MAX86176/MAX30005)

- Single-Lead Event Monitors for Atrial Fibrillation (A-Fib) and other Arrhythmia Detection
- Single-Lead Wireless Patches for At-Home/In-Hospital Monitoring
- Chest-Band Heart-Rate Monitors for Fitness Applications
- Biometric Authentication and ECG-on-Demand Applications

#### PPG-ECG SYNC (MAX86176)

- Fully Synchronized PPG and ECG Signal Path for PTT Measurements

### Benefits and Features

#### PPG (MAX86176)

- Complete Dual-Channel Optical-Data Acquisition System
- Ultra-Low-Power Operation for Wearable Devices
  - Optical Readout Channel < 11µA (typ) at 25fps
  - 14.6µs to 117.1µs ADC Integration Time
  - Low Shutdown Current < 1µA (typ)
- Signal to Noise Ratio (SNR) up to 110dB with Average (Avg) Mode and Off-Chip Filtering
- Supports Frame Rates from 1fps to 2kfps
- High-Resolution 20-bit Charge-Integrating ADCs
- Low Dark-Current Noise of < 50pA<sub>RMS</sub>
- Excellent Ambient Range and Rejection Capability
  - > 100µA Ambient Photodiode Current
  - > 90dB Ambient Rejection at 120Hz (Avg > 2)

#### ECG (MAX86176/MAX30005)

- Clinical-Grade ECG AFE with High-Resolution ADC
  - 15.6 ENOB with 0.6µV<sub>RMS</sub> Noise over 0.05Hz to 40Hz
- Very Low Input-Bias Current (-40°C to +85°C)
  - 233fA<sub>RMS</sub> Input-Current Noise (0.05Hz to 40Hz, T<sub>A</sub> = +25°C)
- Fully Differential Input Structure with CMRR > 110dB at Power-Line Frequencies
- High-Input Impedance > 1GΩ for Extremely Low Common to Differential-Mode Conversion
- High DC-Offset Range of ±1300mV (typ 1.8V) Allows a Wide Variety of Electrodes to be Used
- High AC-Dynamic Range of > 90mV<sub>p-p</sub> Helps Prevent Saturation in the Presence of Motion
- ECG Biopotential Channel Can Be Used for Some EEG Applications
  - Higher-Gain Ranges Available (480V/V, 960V/V)
  - Low Input-Referred Voltage and Current Noise Enables Use of Small-Area Dry Electrodes

#### SYSTEM

- Shutdown Current of 0.5µA (typ)
- 256-Word FIFO for ECG and PPG
- True Synchronous ECG and PPG Data from Dedicated Signal Paths
- Two Fully Configurable Interrupts
- High-Speed SPI Interface or I<sup>2</sup>C Interface
- Small 2.728mm x 2.708mm WLP Package

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

Rev. 3

DOCUMENT FEEDBACK

TECHNICAL SUPPORT

Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices. Trademarks and registered trademarks are the property of their respective owners.

