

MAX86181

High SNR Quad-Channel AFE for Optical Spectroscopy with Dynamic Voltage Scaling

General Description

The MAX86181 is an ultra-low power optical data acquisition system with both transmit and receive channels. On the transmitter side, the MAX86181 has two, high-current 8-bit programmable LED drivers. The MAX86181 can drive up to 24 LEDs. On the receiver side, the MAX86181 has four low-noise charge integrating front ends such that each includes independent 20-bit analog-to-digital converters (ADCs) and best-in-class ambient light cancellation (ALC) circuits, producing the highest performing integrated optical data acquisition system in the market today.

Due to its low power consumption, compact size, ease and flexibility of use, the MAX86181 is ideal for a wide variety of optical sensing applications such as pulse oximetry and heart rate detection.

Working with one of Analog Devices, Inc.'s dynamic voltage scaling/DVS-enabled power management integrated circuit (PMIC), the MAX86181's DVS circuit can dynamically minimize the LED's anode voltage for every measurement (every wavelength and LED current) ensuring optimal SNR while reducing power dissipation on the V_{LED_HSx} rail.

The MAX86181 operates on a 2.5V analog supply voltage, a 3.1V to 5.5V V_{LED_DRV} driver supply voltage, and a 1.8V digital supply voltage. With two integrated LDOs, the MAX86181 can operate on a single 3.3V supply. The device supports both I2C and SPI compatible interfaces in a fully autonomous way. The device has a large 1024-word built-in FIFO. The MAX86181 is available in a compact 42-WLP package.

Applications

- Wearable Devices for Fitness, Wellness, and Medical Applications
 - Suitable for Wrist, Finger, Ear, and Other Locations
 - Optimized Performance to Detect
 - Heart Rate
 - Heart Rate Variability
 - Oxygen Saturation (SpO₂) both Transmissive and Reflective
 - Body Hydration
- Optical Spectroscopy

Benefits and Features

- Complete Quad-Channel Optical Data Acquisition System
- Ultra-Low Power Operation for Body Wearable Devices
 - Low-Power Operation, Optical Readout Channel 17 μ W at 25fps
 - Exposure Integration Period Ranging from 14.6 μ s to 118.2 μ s
 - Low Shutdown Current < 2.3 μ A
- Excellent Top-End SNR = 98.8dB in White Card Loop-Back Test (Nyquist Sample-to-Sample Variance)
- Extended Dynamic Range up to 122dB (Averaging and Off-Chip Filtering)
- Supports Frame Rates from 1fps to 1927fps
- High Resolution 20-Bit Charge Integrating Analog-to-Digital Converters (ADCs)
- Low Dark Current Noise of 52pARMS (Sample-to-Sample Variance in 118.2 μ s Integration Time)
- Excellent Ambient Range and Rejection Capability
 - 200 μ A Ambient Photodetector Current
 - Improved Ambient Light Cancellation to Over 90dB at 120Hz (averaging = 2)
- -40°C to +85°C Operating Temperature Range
- New Features
 - Reduced Analog Front End (AFE) Power Consumption
 - Individualized Sampling Rate per Measurement
 - Low Dark Noise Mode (LDNM) Enables Dark Noise of 10pARMS
 - Dynamic Voltage Scaling for V_{LED_HSx} Supplies
 - Auto-Offset DAC Mode—Optional Automatic Mode which Effectively Expands Dynamic Range without Microcontroller Intervention

• [Ordering Information](#) appears at end of data sheet.

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
Rev Sp0	03/24	Initial release	---
Rev Sp1	08/24	Note added at the end of <i>Optical Transmitter Overview</i> section with recommendation to set LED_NOAZ = 1; LED_NOAZ bit description modified; TOC17, TOC18, and TOC19 edited to show results with condition LED_NOAZ = 1; ALC_OVF and EXP_OVF bit description edited to clarify the mechanism to clear them once set; Note added in <i>FIFO Description</i> after Table 5 to clarify the clearing mechanism of bits ALC_OVF and EXP_OVF; Added Figure 2 added (driving back-to-back LEDs); Added 'Transmissive SpO2 cable' application circuit in the <i>Typical Application Circuits</i> section; Table 5 edited to show correct COLLECT_RAW_DATA condition	1, 7
Rev 2	05/25	Corrected note references in the Electrical Characteristics table; Updated the TOC2 and TOC24; Revised the <i>Dynamic Voltage Scaling</i> section; Updated the Register Map; Aligned the figures in the <i>Typical Application Circuits</i> section; and Added a note in the Detailed Description; Rev Sp2 changed to Rev 2.	4, 5, 6, 7, 8, 9, 10, 11, 13, 18, 31, 106, 238, 239

