

# AFE49I30 Ultra-Small, Integrated AFE With FIFO for Multi-Sensor Wearable, Optical Heart-Rate Monitoring and Bio-sensing

## 1 Features

- Supports signal acquisition of up to 24 phases
- Flexible allocation of 6 LED, 4 PD in each PPG phase
- Synchronized PPG/ECG signal acquisition with each phase configurable as PPG or ECG, and at different data rates
- Synchronized PPG/ECG supports up to 1 kHz data rate
- ECG-only mode supports up to 4 kHz data rate
- PPG signal chain:
  - System SNR up to 108-dB at 16  $\mu$ A PD current
  - Low current for continuous operation on a wearable device with a typical value: 15  $\mu$ A for an LED, 20  $\mu$ A for the receiver
- PPG Transmitter:
  - Supports common anode LED configuration
  - 8-Bit programmable LED current with range adjustable from 25 mA to 250 mA
  - Mode to fire two LEDs in parallel with independent per-phase current control
  - Programmable LED on-time per-phase
  - Simultaneous support of 6 LEDs for SpO<sub>2</sub>, HRM, or multi-wavelength HRM
- PPG Receiver:
  - Supports 4 time-multiplexed photodiode inputs
  - 2 parallel receivers to sample two PD channels simultaneously
  - Individual ambient offset subtraction DAC at each TIA Input with 8-bit per-phase control and range adjustable up to 255- $\mu$ A
  - Individual LED offset subtraction DAC at each TIA input with 5-bit per-phase control and 15.5- $\mu$ A range
  - Close to 100 dB ambient rejection up to 10 Hz
  - Noise filtering with programmable bandwidth
  - Transimpedance Gain: 3.7 k $\Omega$  to 1 M $\Omega$
- ECG Signal Chain
  - 1-lead ECG with RLD output for bias
  - INA gain programmable from 1.6 – 13
  - <1  $\mu$ Vrms input noise (in a 1-150 Hz bandwidth) at 4-kHz sample rate
  - Integrated 450 Hz Low Pass Filter
  - AC, DC lead-off detect with 3.125-100 nA current and programmable interrupt

- Supports external clock and internal oscillator modes
- Option to acquire data synchronized with a system master clock
- Automatic cancellation of DC from ambient, LED
- FIFO with 128-sample depth
- I<sup>2</sup>C interface
- 2.6-mm x 2.1-mm DSBGA, 0.4-mm pitch
- Supplies: Rx: 1.7 V-1.9 V (LDO bypass); 1.9 V-3.6 V (LDO enabled), Tx: 3 V-5.5 V, IO: 1.7-3.6 V
- Supports operation with 2 supplies - 1.8 V, 5 V

## 2 Applications

- ECG on a wearable device
- Synchronized PPG, ECG for PTT-based Blood pressure
- Optical heart-rate monitoring (HRM) and Heart-rate variability (HRV) for wearables, hearables
- Pulse oximetry (SpO<sub>2</sub>) measurements
- Maximum oxygen consumption (VO<sub>2</sub> Max)

## 3 Description

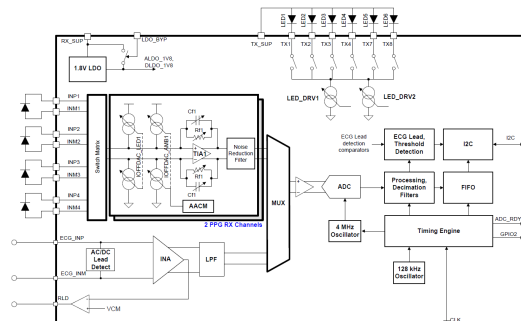
The AFE49I30 is an analog front-end for optical bio-sensing/ PPG and ECG measurement applications. The device supports up to six switching light-emitting diodes (LEDs) and up to four photodiodes. Up to 24 signal phases can be defined and the PPG or ECG signals can be acquired from each phase in a synchronized manner.

### Device Information<sup>(1)</sup>

PART NUMBER	PACKAGE	BODY SIZE (NOM)
AFE49I30	DSBGA (30)	2.60 mm x 2.10 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

### Simplified Schematic



## 4 Device and Documentation Support

### 4.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

### 4.2 Support Resources

TI E2E™ [support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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### 4.3 Trademarks

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### 4.4 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### 4.5 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

## 5 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
AFE49I30YZR	ACTIVE	DSBGA	YZ	30	3000	RoHS & Green	SAC396	Level-1-260C-UNLIM	-40 to 85	AFE49I30	<a href="#">Samples</a>
AFE49I30YZT	ACTIVE	DSBGA	YZ	30	250	RoHS & Green	SAC396	Level-1-260C-UNLIM	-40 to 85	AFE49I30	<a href="#">Samples</a>

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
AFE49I30YZR	DSBGA	YZ	30	3000	178.0	9.2	2.27	2.72	0.78	4.0	8.0	Q1
AFE49I30YZT	DSBGA	YZ	30	250	178.0	9.2	2.27	2.72	0.78	4.0	8.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
AFE49I30YZR	DSBGA	YZ	30	3000	220.0	220.0	35.0
AFE49I30YZT	DSBGA	YZ	30	250	220.0	220.0	35.0

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
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