AFE44I30 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 phase
- Simultaneous signal acquisition from different sensors at different data rates
- Accurate, continuous heart-rate monitoring:
  - System SNR up to 108-dB at 16 μA PD current
  - Low current for continuous operation on a wearable device with a typical value: 15 μA for an LED, 20 μA for the receiver
- 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_2, HRM, or multi-wavelength HRM
- Receiver:
  - Supports 4 time-multiplexed photodiode inputs
  - 2 parallel receivers (two sets of TIA/filter)
  - Individual ambient offset subtraction DAC at each TIA Input with 8-bit per-phase control and range adjustable up to 255-μA
  - Individual LED offset subtraction DAC at each TIA input with 5-bit per-phase control and 15.5-μA range
  - Close to 100 dB ambient rejection up to 10 Hz
  - Noise filtering with programmable bandwidth
  - Transimpedance Gain: 3.7 kΩ to 1 MΩ
- 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^2C interface
- 2.6-mm × 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

2 Applications

- Optical heart-rate monitoring (HRM) for wearables, hearables
- Heart-rate variability (HRV)
- Pulse oximetry (SpO_2) measurements

3 Description

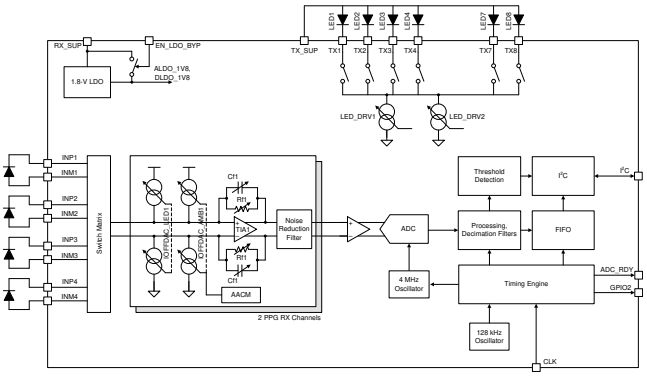
The AFE44I30 is an analog front-end for optical bio-sensing applications, such as heart-rate monitoring (HRM) and saturation of peripheral capillary oxygen (SpO_2). The device supports up to six switching light-emitting diodes (LEDs) and up to four photodiodes. Up to 24 signal phases can be defined and the signal can be acquired from each phase in a synchronized manner. The current from the photodiode is converted into voltage by the transimpedance amplifier (TIA) and digitized using an analog-to-digital converter (ADC). The ADC code can be stored in a 128-sample First in, First out (FIFO) block. The FIFO can be read out using a I^2C interface. The AFE also has a fully-integrated LED driver with an 8-bit current control. The device has a high dynamic range transmit-and-receive circuitry that helps with the sensing of very small signal levels.

Device Information[1]

PART NUMBER	PACKAGE	BODY SIZE (NOM)
AFE44I30	DSBGA (30)	2.60 mm × 2.10 mm

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

Simplified Schematic



An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

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.

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PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
AFE44I30YZR	Active	Production	DSBGA (YZ) | 30	3000 | LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	AFE44I30
AFE44I30YZR.A	Active	Production	DSBGA (YZ) | 30	3000 | LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	AFE44I30
AFE44I30YZT	Active	Production	DSBGA (YZ) | 30	250 | SMALL T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	AFE44I30
AFE44I30YZT.A	Active	Production	DSBGA (YZ) | 30	250 | SMALL T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	AFE44I30

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **Lead finish/Ball material:** Parts 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.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

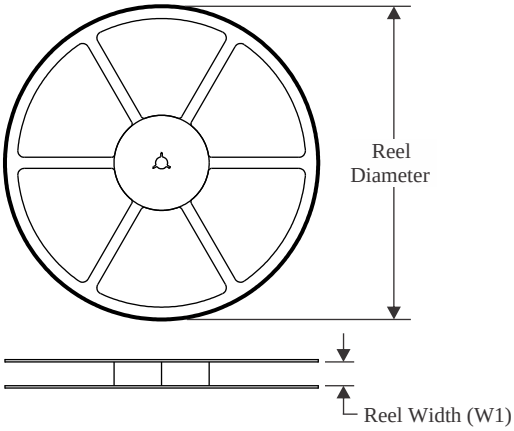
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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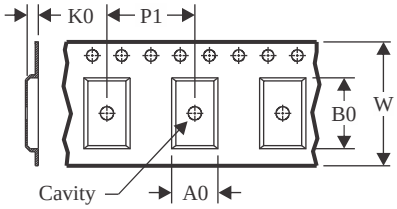
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TAPE AND REEL INFORMATION

REEL DIMENSIONS

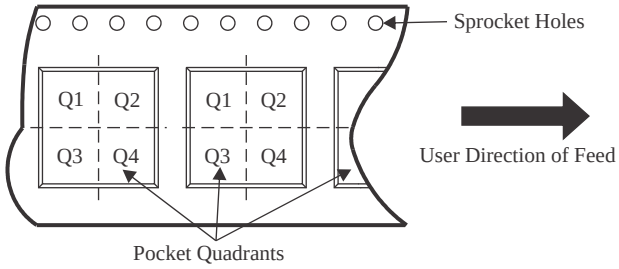


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

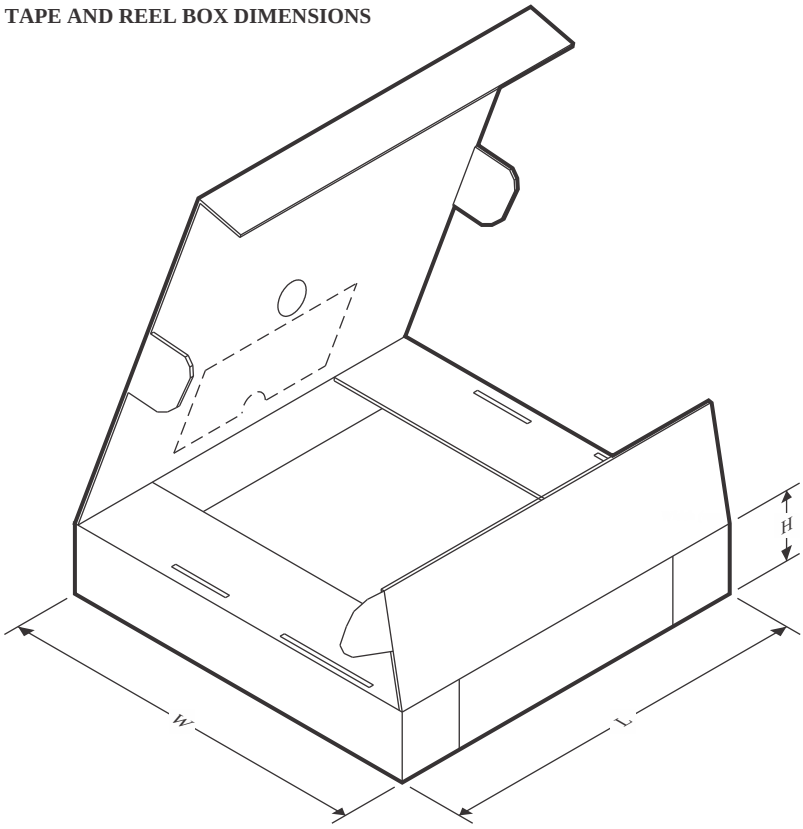
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
AFE44I30YZR	DSBGA	YZ	30	3000	180.0	8.4	2.26	2.74	0.81	4.0	8.0	Q1
AFE44I30YZT	DSBGA	YZ	30	250	180.0	8.4	2.26	2.74	0.81	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)
AFE44I30YZR	DSBGA	YZ	30	3000	210.0	185.0	35.0
AFE44I30YZT	DSBGA	YZ	30	250	210.0	185.0	35.0

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