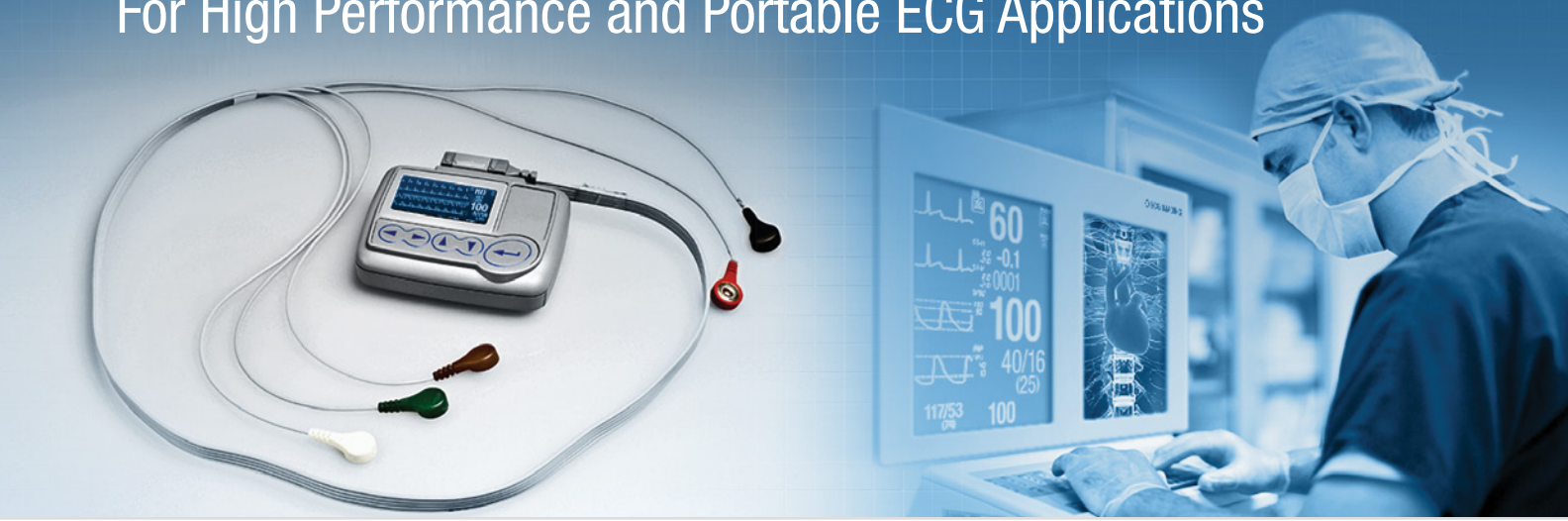
ADAS1000 5-Electrode ECG AFE

For High Performance and Portable ECG Applications



The ADAS1000 5-electrode electrocardiography (ECG) analog front end (AFE) addresses the challenges facing designers of next generation, low power, low noise, high performance, tethered and portable ECG systems. The ADAS1000 chip consists of five electrode inputs and a dedicated right leg drive (RLD) output reference electrode and has been designed for both monitor and diagnostic quality ECG measurements.

In addition to supporting the essential elements of monitoring ECG signals, the ADAS1000 is equipped with functionality such as respiration measurement (thoracic impedance measurement), pace artifact detection, lead/electrode connection status, and internal calibration features.

One single ADAS1000 supports five electrode inputs, easily enabling a traditional 6-lead ECG measurement. Cascading a second ADAS1000 device allows scaling of the system to a true 12-lead measurement, while cascading multiple devices (three and above) scales the system to a 15-lead measurement and beyond.

Respiration

The ADAS1000 has an integrated DAC respiration drive at a programmable frequency (46 kHz to 64 kHz) and an ADC measure circuit that simplifies this difficult measurement. The measurement is demodulated and provided to the user as magnitude and phase from which they can determine the corresponding respiration, given their specific cable parameters. The circuit is capable of detecting down to 200 mΩ resolution using the internal capacitor and to lower resolutions using an external capacitor and has a flexible switching scheme allowing measurement on one of three leads (I, II, III).

Pace Detection Algorithm

The pace detection algorithm runs three instances of a digital algorithm on three of four possible leads (I, II, III, aVF). It runs on the high frequency ECG data in parallel with the internal decimation and filtering. It's been designed to detect and measure pacing artifacts of widths ranging from 100 μs to 2 ms and amplitudes of 400 μV to 1000 mV. The ADAS1000 returns a flag that indicates pace was detected on one or more of the leads, as well as the measured height and width of the detected signal. In the event that a user wishes to run their own digital pace algorithm, the ADAS1000 provides a high speed pace interface providing the ECG data at a fast data rate (128 kHz), with the filtered and decimated ECG data remaining on the standard interface.

Low Power

Designed for low power, the ADAS1000 operates five ECG electrode measurements from as little as 21 mW. To further minimize overall power dissipation in applications such as battery-operated Holter and telemetry, any unused channels or features can be conveniently disabled to further minimize power to as low as 11 mW for one lead.

Low Noise

Low noise performance is critical for appropriate diagnosis of different conditions. The ADAS1000 noise performance is 10 μV p-p over 0.05 Hz to 150 Hz to support end equipment regulatory standards. The ADAS1000 offers methods of trading off noise performance, power, and data rate—making it suitable to a wide variety of end products. In line-powered ECG systems, where power isn't a major concern, the ADAS1000 performance excels. Device noise performance can be improved using the high performance mode (where the sample rate of on-board SAR ADCs increases to reduce noise).

Flexible Configurations for Expansion

While the ADAS1000 has been designed for five electrode inputs, it readily expands to systems with larger electrode/lead counts. Cascading multiple ADAS1000 devices allows scaling of the system to a true 12-lead or 15-lead measurement or beyond.

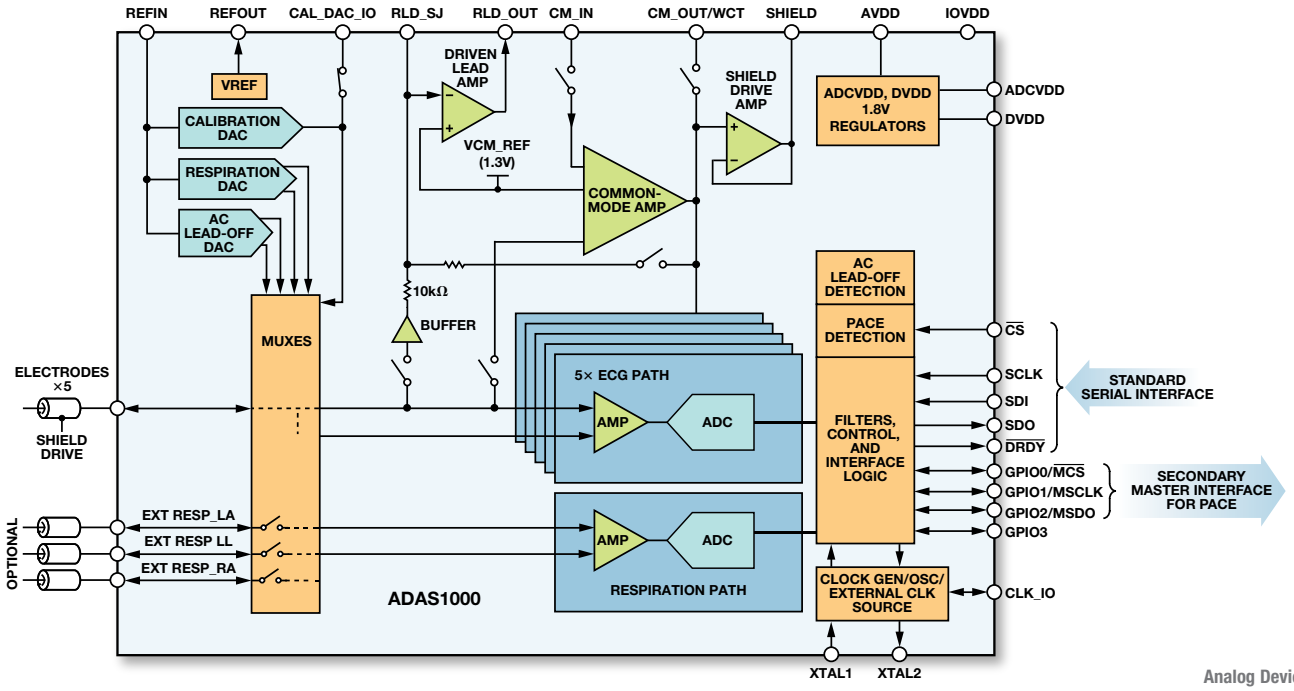
Flexible Data Rates

The standard serial interface outputs all the information related to the ECG, including LEADS OFF status, pace, respiration, and other auxiliary functions. The large number of 32-bit or 16-bit data words, collectively known as a packet or frame, is put onto the serial SDO pin of the data bus. Different data frame rates (2 kHz, 16 kHz, 128 kHz) are available to ensure ultimate ease in data capture. The slowest data rate of 2 kHz allows for more decimation and is the premium frame data rate for low noise performance. It's also possible to read data in "skip" mode, which reads the packet or frame from the device only every second or third word. The slowest data rate is 500 Hz.

Small Form Factor

This 5-electrode device is available in a RoHS-compliant 9 mm × 9 mm LFCSP or 12 mm × 12 mm LQFP package.

ADAS1000 Functional Block Diagram



ADAS100x ECG AFE Roadmap

Part Number	Number of Electrodes	Extra Features	Input Noise, 0.05 Hz to 150 Hz (μV p-p)*	CM I/P Range (V)	Supply Rail (V)	Temperature	Package
ADAS1000	5 ECG electrodes + RLD	Respiration pace + I/F	10	±1	3.3 to 5.5	–40°C to +85°C	56-lead LFCSP, 64-lead LQFP
ADAS1000-2	5 ECG electrodes (companion chip for gang purposes)	—	10	±1	3.3 to 5.5	–40°C to +85°C	56-lead LFCSP
ADAS1000-1	5 ECG electrodes + RLD (no pace algorithm, includes pace I/F)	Pace I/F	10	±1	3.3 to 5.5	–40°C to +85°C	56-lead LFCSP

*Noise performance measured in 2 kHz data rate with a gain of 2.8, providing a ±0.5 V common-mode input range.

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