Product Overview

First High-Precision Instrumentation Amplifier With Fully-Differential Outputs

Introducing the first instrumentation amplifier with fully-differential outputs (INAFDA) in the industry, the INA851. The INA851 integrates a two-amplifier input gain stage and a differential amplifier output stage into a one-chip solution. The INA851 redefines the instrumentation amplifier landscape by offering an integrated design within the performance and price range of a discrete design.

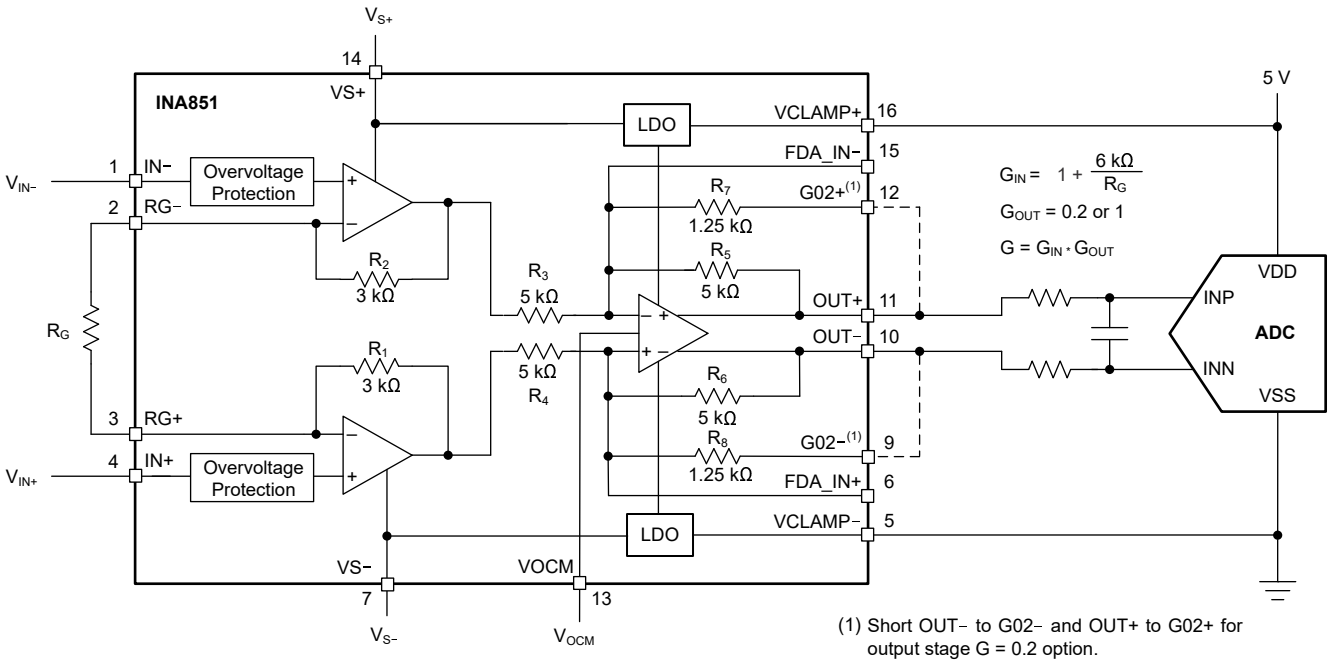

Figure 1. INA851 ADC Driver Application

Design Considerations

- Input overvoltage protection of up to ±40 V
- Attenuating gain down to 0.2 V and up to a gain of 10,000
- Single external resistor to set gain
- External access pin for additional noise filtering

The output driver has a built-in clamping circuit, featuring an integrated low-dropout (LDO), designed to protect the succeeding signal chain, typically an analog-to-digital converter (ADC). When connecting the ADC power supply pins to the INA851 clamp pins, the INA851 output voltage is clamped at 600 mV above the ADC power supply voltage to protect the ADC and downstream devices against overdrive damage, without experiencing distortion.

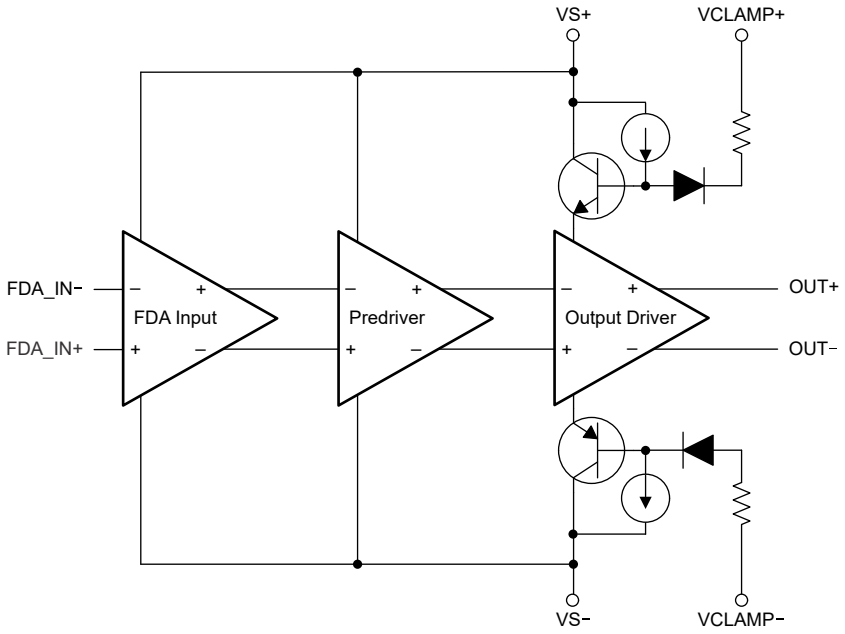

Figure 2. Simplified Schematic of Output Driver Clamping Structure

Due to the additional LDO functionality in the output stage, the input and output range calculation comes with more complexity compared to traditional INAs. To help understand the device functionality and ease device implementation, TI created the *INA851 Input and Output Range Design Calculator*, available for download online. The tool calculates the input and output range based on the power supply voltage, as well as input common mode range and differential output based on user inputs. The calculator also provides a visual graphical display of the resulting range, to better highlight device versatility. Figure 3 shows the GUI in the calculator.

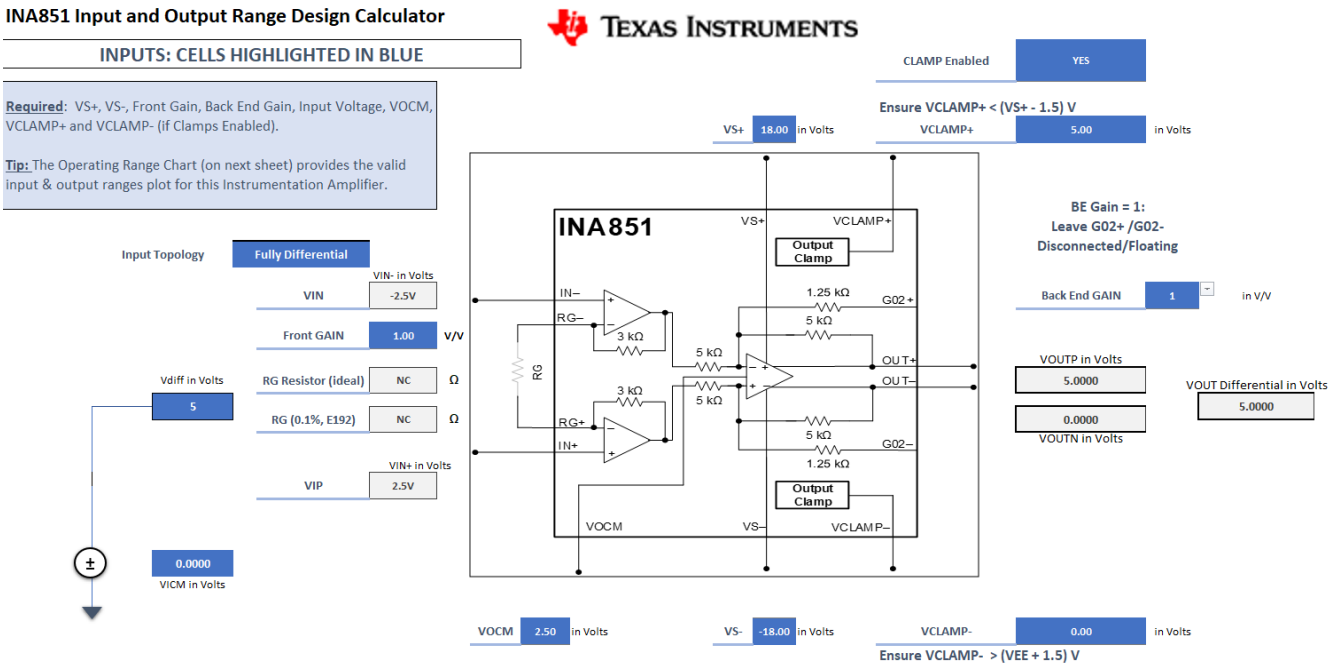

Figure 3. INA851 Input and Output Range Design Calculator

The integrated design offered by the INA851 also incorporates precision ratiometric resistors in the FDA output stage, improving accuracy while reducing the errors due to resistor mismatch. Overall, the INA851 reduces design component count, in turn reducing printed-circuit-board (PCB) area compared to discrete solutions by 46%, based on a typical strain gauge application. Figure 4 compares a typical discrete design layout including the dual op-amp input gain stage, differential driving amplifier, resistor network, and decoupling capacitors, resulting in a total design size of 255.6 mm² compared to the INA851 integrated design size of 137.16 mm².

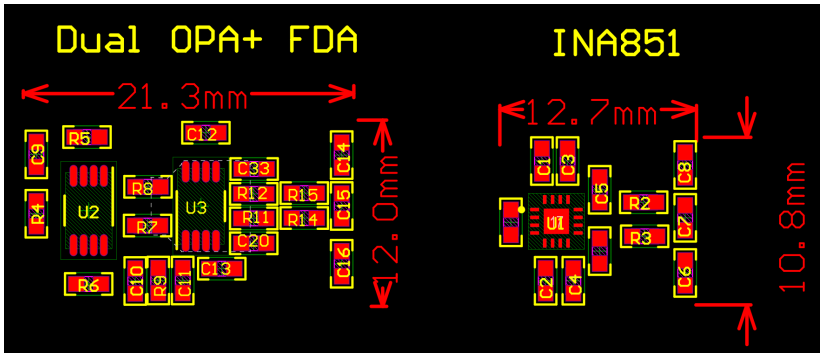

Figure 4. PCB Size Comparison

Part Number(1)	Maximum Operating Voltage	Features
INA851	36 V	Low-noise (3.2 nV/√Hz) high-speed (22 MHz) fully-differential instrumentation amplifier with OVP (±40 V)
INA849	36 V	Single-ended, ultra-low noise (1 nV/√Hz), high-speed (28 MHz, 35 V/µs), precision (35 µV) instrumentation amplifier
PGA855	36 V	Low-noise, wide-bandwidth, fully-differential-output programmable-gain instrumentation amplifier

(1) For more devices, see the *online parametric tool*

For additional assistance, ask questions to TI engineers on the *TI E2E™ Amplifier Support Forum*.

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

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