

Dual ADC Driver with Tightly Matched Gain and Phase Raises Quadrature Demodulation Performance

by Kris Lokere

Introduction

High speed differential amplifiers help to drive high performance analog-to-digital converters (ADCs) by providing balanced drive to the differential input stage, setting the common mode level, absorbing the sampling-energy, and taking gain to reduce the output swing requirement of preceding circuitry. In applications involving multiple ADCs, a compact, tightly matched dual differential amplifier such as the LTC6420-20 can further simplify the design by reducing the uncertainty of channel-to-channel variations.

The LTC6420-20 features two 1.8GHz differential amplifiers, each capable of driving 12-, 14- and 16-bit pipeline ADCs at low noise and low distortion levels, even for input frequencies as high as 300MHz. The internal op amps are manufactured on a Silicon Germanium (SiGe) process and feature an ultra-low $1\text{nV}/\sqrt{\text{Hz}}$ noise density. Even after factoring in

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the internal feedback resistors, the total input noise density equals only $2.2\text{nV}/\sqrt{\text{Hz}}$. The channel-to-channel gain matching is production tested and guaranteed to be better than $\pm 0.25\text{dB}$. Moreover, the monolithic design ensures that both phase and group delay remain tightly matched over the entire bandwidth of the amplifiers.

The dual amplifier is available in a $3\text{mm} \times 4\text{mm}$ QFN package, which saves space compared to two single

amplifiers. For further space-savings, all gain and feedback resistors are included on-chip, setting a fixed voltage gain of 20dB. The LTC6420-20 consumes 80mA per channel from a supply as low as 2.85V. A 40mA version, the LTC6421-20, is available to save power at the expense of usable input bandwidth.

Wideband Interface Between an I/Q Demodulator and a Dual ADC

When an IF or RF signal is applied to a demodulator such as the LT5575, the signal's information is separated out into two baseband signals: "in-phase" (I) and "quadrature" (Q). Both baseband signals need to be digitized simultaneously, and it is critical that the relationship of gain and phase between the two is maintained. Furthermore, if you want to maximize the dynamic range by driving the dual

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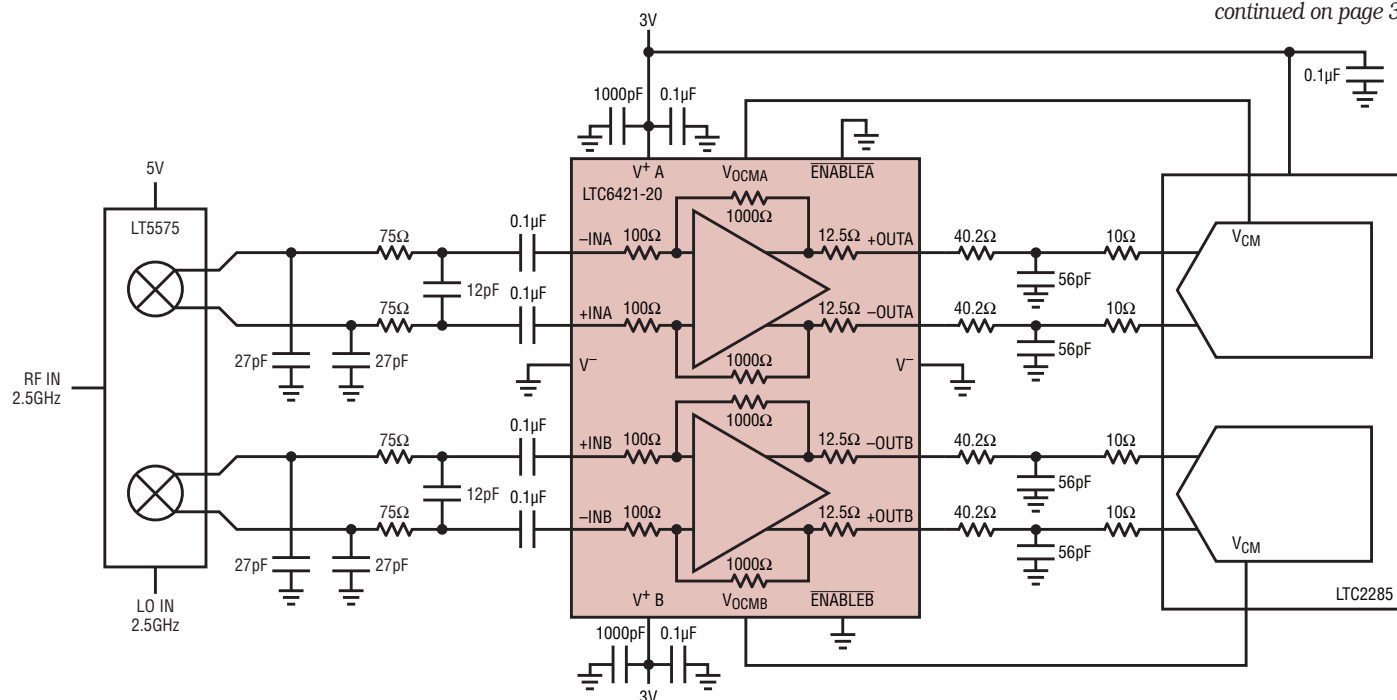


Figure 1. The voltage gain of the LTC6421-20 reduces the output swing requirements of the LT5575 demodulator. This improves overall system linearity.

internal Schottky diode between CAP and BOOST, which saves an external component for applications with two or more series LEDs (see Figure 2 for a single LED solution).

Rugged Solution for Tough Environments

In addition to an internal switch current limit circuit, the LT3592 includes a catch diode current sense limit function that protects the circuit during start-up at high input voltages. Simply connect the anode of the Schottky catch diode to the DA pin, and the LT3592 automatically reduces the oscillator frequency when the catch diode current is higher than 1A. The lower operating frequency prevents the inductor current from ramping up in an uncontrolled fashion and allows the switch current limit to be effective by avoiding minimum on time restrictions. The LT3592 also automatically reduces its operating frequency if the LED string shorts out, minimizing power dissipation in the part.

The SHDN and BRIGHT pins are as rugged as the V_{IN} pin and can with-

stand up to 36V, so they can be tied to the input voltage. Nevertheless, both pins have low voltage thresholds that allow them to be directly interfaced to low voltage microcontrollers.

The LT3592 is not only useful for LED applications. It has a fully functional voltage control loop, and the current loop can be used as an accurate current clamp for voltage output applications. The voltage loop is also useful as a voltage clamp in case of an open LED fault. The transition between voltage and current control is stable and seamless.

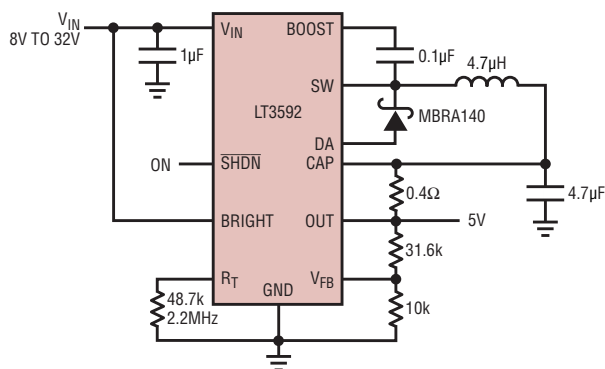



Figure 5. A 5V power supply with a 500mA current limit

Conclusion

The LT3592 makes 2-state bright/dim LED control simple and rugged. It is an ideal solution for applications such as automotive brake lights and flashing warning lights in industrial systems. Accurate control of the current levels makes LED brightness consistent across units in a given application regardless of varying LED forward voltage characteristics. Switching between the two current levels can be accomplished with either very low or very high voltage level digital signals. 

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ADC close to full scale, without driving the demodulator so hard that it causes excessive distortion, you need to insert some gain between the demodulator output and the ADC input. In Figure 1, the LTC6421-20 provides this gain, while the tight matching between its two channels contributes

a negligible amount of gain or phase error. The bandwidth and linearity of the LTC6421-20 ensures that 14-bit linearity (distortion less than -84dBc) is maintained to 50MHz and beyond, an important design criteria in digital-predistortion (DPD) circuits or wideband receivers.

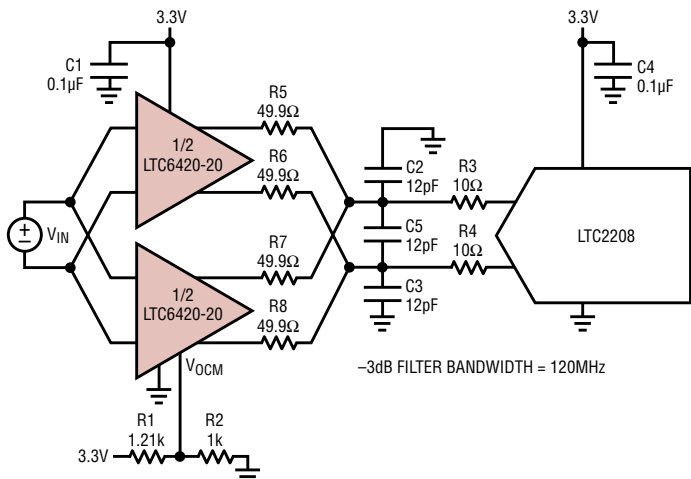


Figure 2. Connecting the two channels of the LTC6420-20 in parallel reduces the noise floor

Paralleling Two Drivers to Lower the Noise Floor

In applications with only one ADC, you can hook-up the two channels of the dual amplifier in parallel, as shown in Figure 2. The main benefit of doing so is a reduction in noise, because the random noise contributions of each channel get averaged out. For example, input noise density (with inputs shorted) drops from $2.2\text{nV}/\sqrt{\text{Hz}}$ to $1.5\text{nV}/\sqrt{\text{Hz}}$, a 3dB improvement in SNR if the driver were the dominant noise source.

Conclusion

The LTC6420 features two high speed differential amplifiers in a small $3\text{mm} \times 4\text{mm}$ QFN package, with guaranteed tight matching specs between the two channels. It is ideal for driving high frequency signals into dual ADCs, especially when board space is limited or when the magnitude and phase relationship between the signals must be preserved. 