



# DESIGN NOTES

## New 16-Bit, 100ksps A/D Converter Runs on 5V Supply

Design Note 165

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The LTC<sup>®</sup>1605 is a new 16-bit, 100ksps ADC from Linear Technology. Its outstanding DC accuracy and  $\pm 10\text{V}$  analog input range are ideal for industrial control and instrumentation applications. Its simple I/O, low power and high performance make it easy to design into applications requiring wide dynamic range and high resolution.

### Product Features

- No missing codes and  $\pm 2\text{LSB}$  max INL over temperature
- Single 5V supply with 55mW typical power dissipation
- $\pm 10\text{V}$  analog input with  $\pm 20\text{V}$  overvoltage protection for harsh environments
- Complete ADC contains sample-and-hold and reference
- 28-pin PDIP, SO and SSOP packages

### Circuit Description

The LTC1605 converts  $\pm 10\text{V}$  analog input signals while operating on a 5V supply. A resistor network is used to attenuate the input signal. This reduced internal signal

is digitized by a differential, switched-capacitor, 16-bit SAR ADC at a rate of up to 100ksps. The differential architecture provides high immunity to power supply and other external noise sources. The trimmed 2.5V bandgap reference can be overdriven with an external reference if desired.

The digital interface is simple. Conversions are started using the read-convert (R/C) pin. Data is available as a 16-bit word or two 8-bit bytes.

### AC and DC Performance

Figure 2 shows the fast Fourier transform (FFT) of a  $\pm 10\text{V}$  1kHz sine wave signal digitized at 100ksps by the LTC1605. The LTC1605 achieves a signal-to-noise and distortion (SINAD) of 87.5dB and very low total harmonic distortion (THD) of  $-101.7\text{dB}$ .

Figure 3 shows an INL error plot for the LTC1605. Guaranteed specifications include  $\pm 2.0\text{LSB}$  INL (max) and no

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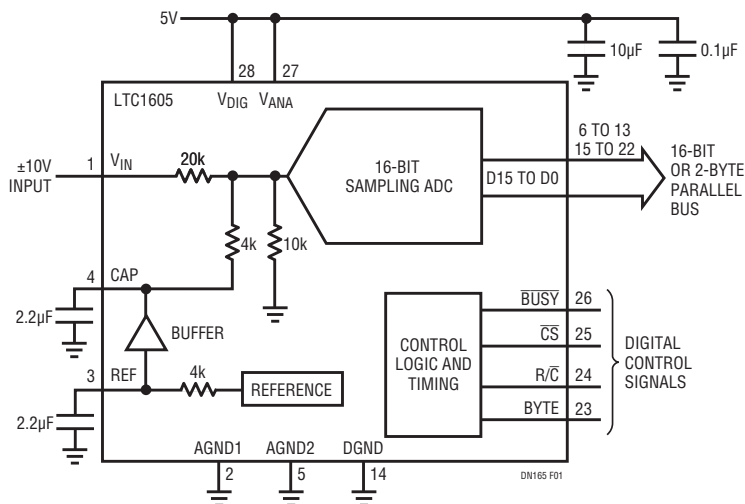


Figure 1. Offering 16-Bit Performance, the LTC1605 Handles  $\pm 10\text{V}$  Inputs While Operating on a Single 5V Supply

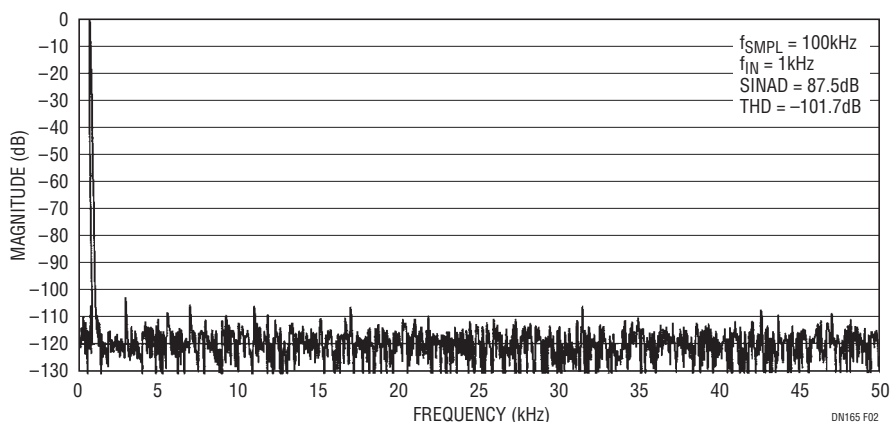


Figure 2. The LTC1605's AC Performance Achieves a 87.5dB SINAD and -101.7dB THD

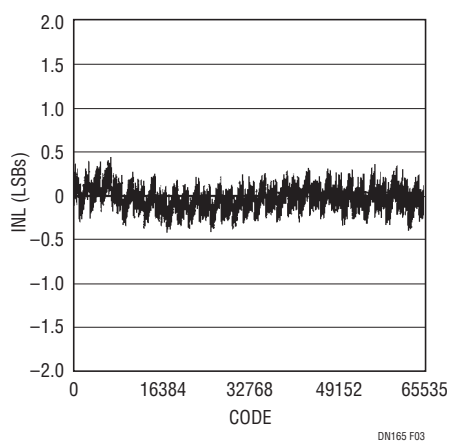


Figure 3. The LTC1605 Achieves Excellent INL Without Cumbersome Autocalibration

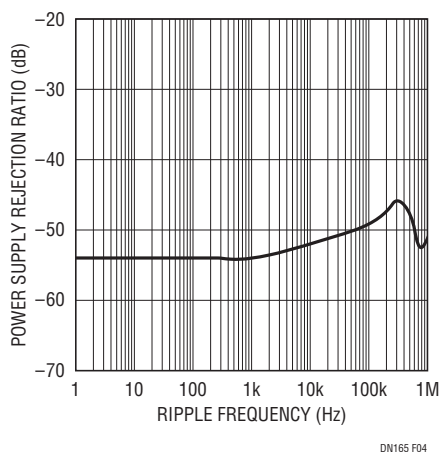


Figure 4. The LTC1605's Differential Architecture Provides Good, Wideband Supply Rejection

missing codes at 16 bits over the industrial temperature range (-40°C to 85°C). The ADC's outstanding accuracy is assured by factory trimming. For the user, this eliminates the software overhead and calibration time delays associated with autocalibrated ADCs.

One of the benefits of the LTC1605's differential architecture is its high power supply rejection ratio (PSRR). Figure 4 shows the power supply rejection ratio of the LTC1605 as a function of frequency.

High PSRR is important to the LTC1605's conversion accuracy and signal-to-noise performance because, at 16-bit quantization, the LSB magnitude is just 305µV ( $V_{IN} = 20V_{P-P}$ ). The LTC1605's high PSRR rejects up to 100mV of power supply noise to below an LSB level.

### Applications

With its overvoltage protected  $\pm 10V$  analog input, the LTC1605 fits easily into industrial process control, power management, data acquisition boards and has sufficient speed for multiplexed applications. The LTC1605 is also ideal for wide-dynamic-range applications that use a PGA and lower resolution ADC. For example, the LTC1605 is a simpler solution and will out perform (in terms of DNL, INL and S/N) a 12-bit ADC converting the output of a PGA with a gain range of 1-to-16.

### Conclusion

The LTC1605 is a complete 16-bit ADC with a built-in sample-and-hold and reference. Its wide analog input range, overvoltage protection and DC accuracy make it a good candidate for industrial process control, instrumentation and other high dynamic range applications.

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