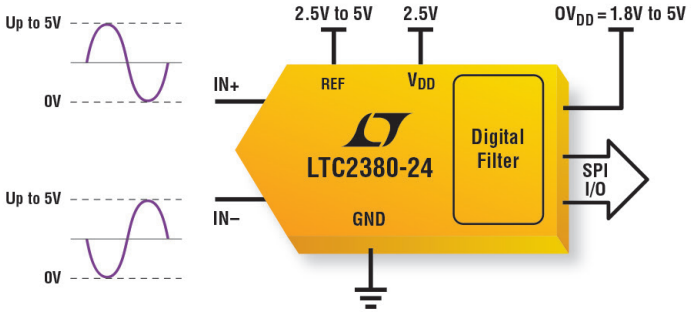
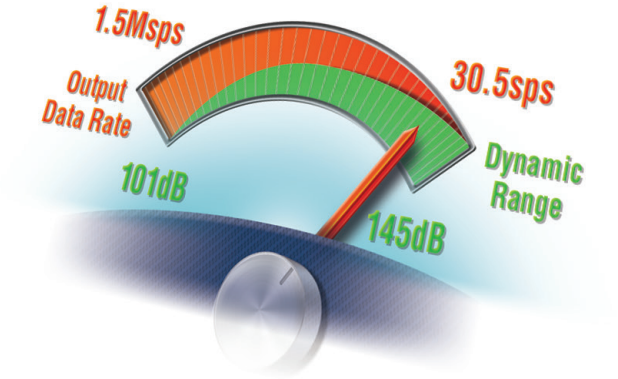
# 24-Bit 2Msps SAR ADC




# 145dB Dynamic Range

## Digital Averaging Filter Simplifies Interfacing to µProcessors

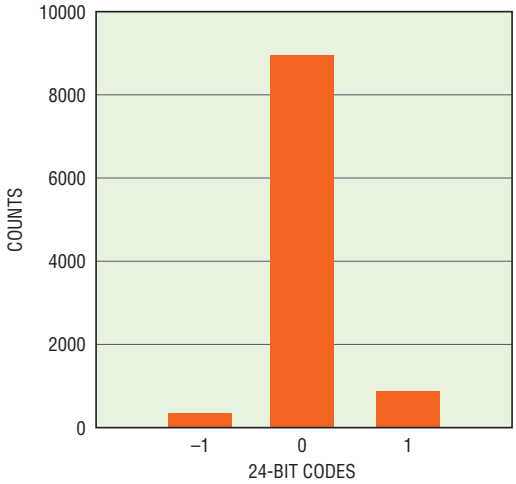
The LTC®2380-24 is a breakthrough no-latency 24-bit 2Msps SAR ADC. An integrated digital filter reduces noise to achieve true 24-bit dynamic range. The LTC2380-24 features a unique digital interface, enabling results to be read with a slow serial clock, easing interfacing to microprocessors. The DC histogram measured with an output data rate of 30.5sps (65536 averages) shows less than $1LSB_{RMS}$ transition noise. The LTC2380-24 targets industrial and instrumentation applications requiring high dynamic range.

### Features

- Guaranteed 24-Bit No Missing Codes
- Integrated Digital Filter
- 101dB Dynamic Range (Typ) at 1.5Msps
- 145dB Dynamic Range (Typ) at 30.5sps
- ±0.5ppm INL (Typ)
- –117dB THD (Typ) at $f_{IN}$ = 2kHz
- Low Power: 28mW at 2Msps
- 50Hz/60Hz Rejection
- Single 2.5V Supply
- 16-Lead MSOP and 4mm × 3mm DFN Packages

| | | 1Msps | 2Msps |
|---|---|---|---|
| 24-Bit with Integrated Digital Filter | Fully Differential 100dB SNR at 1.5Msps | | 2380-24 |
| | Pseudo-Differential 98dB SNR at 1Msps | 2368-24 | |
| 20-Bit | Fully Differential 104dB SNR at 1Msps | 2378-20 | |

**DC Histogram**
**200nV$_{RMS}$ Noise @ 30.5sps**



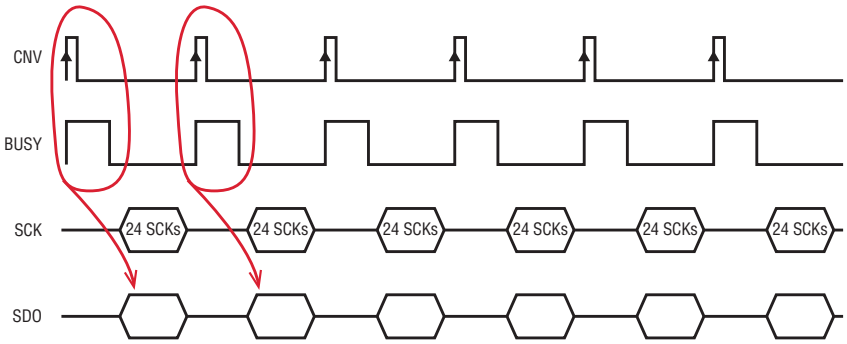

LINEAR TECHNOLOGY

# Digital Filter Requires **No** Programming or Configuration

The digital filter inside the LTC2380-24 automatically averages N consecutive conversion results until the filter output is read from the device. When the filter output result is read, the digital filter is reset and a new averaging operation starts with the next conversion result. An optional distributed read operation lowers the serial data clock's rate to as low as one clock per sample. With the distributed read operation, the maximum sampling rate increases to 2Msps.

## Example of Reading Data with No Averaging

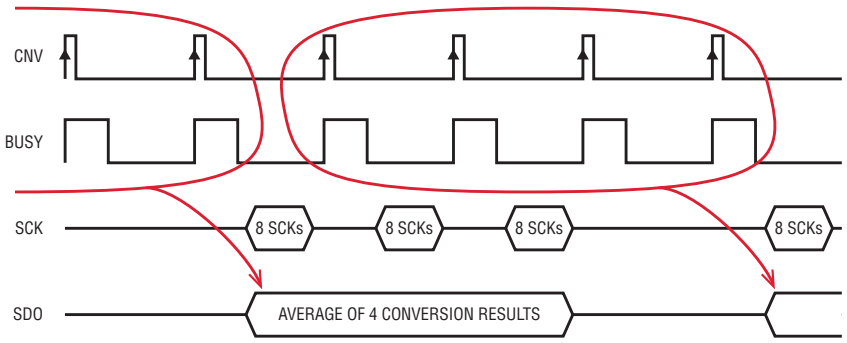
**Max $f_{SMPL}$ = 1.5Msps**




Reading all 24 bits in one cycle results in no averaging and no latency

## Example of Averaging Four Samples Using Distributed Read

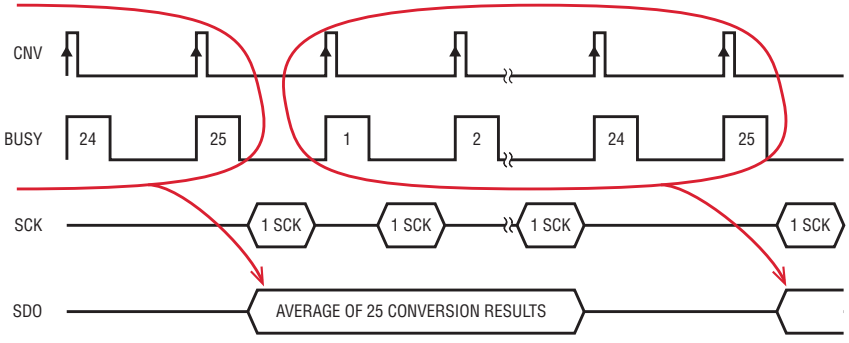
**Max $f_{SMPL}$ = 2Msps**




Distributing the read operation over three ADC cycles to average four samples and slow down the serial interface

## Example of Averaging 25 Samples Using Distributed Read

**Max $f_{SMPL}$ = 2Msps**




Distributing the read operation over 24 ADC cycles to average 25 samples and run the serial interface as slow as 2MHz

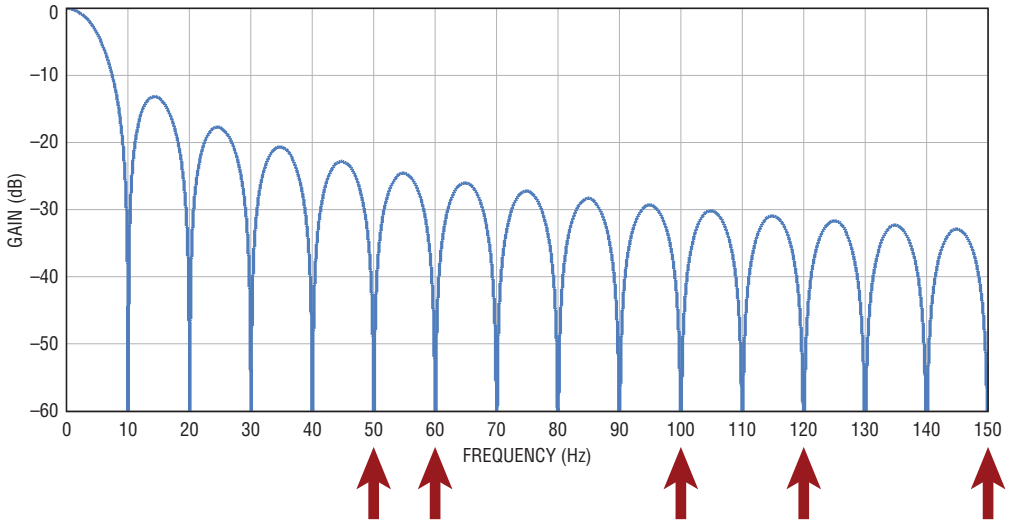
# Reject Particular Input Frequencies

The LTC2380-24's integrated digital filter exhibits a sinc[1] function which allows the rejection of a particular input frequency or a combination of frequencies and their harmonics. This is done by selecting the appropriate number of averages, N, based on the sampling rate, $f_{SMPL}$, and the desired frequency to be rejected, $f_{REJECT}$. N is then given by

$$N = \frac{f_{SMPL}}{f_{REJECT}}$$

For example, the rejection of 50Hz and 60Hz with their harmonics is desired in a large number of applications. Setting $f_{REJECT}$ = 10Hz (of which 50Hz and 60Hz are multiples) and $f_{SMPL}$ = 10.24ksps, results in N = 1024 averages. The frequency response of the digital filter using these settings is shown below.

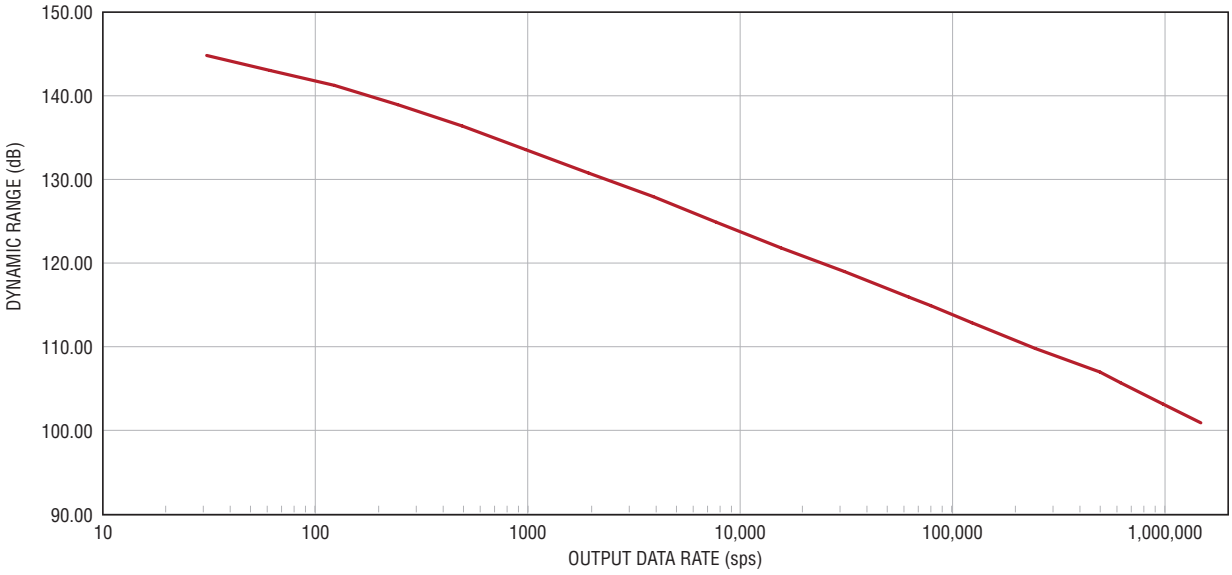
50Hz/60Hz Rejection Example




Excellent Rejection at 50Hz, 60Hz and Their Harmonics

# Dynamic Range vs Output Data Rate

The digital filter can average 1 to 65536 conversion results in real time. This dramatically improves the dynamic range from 101dB at 1.5Msps to 145dB at an output data rate of 30.5sps, achieving true 24-bit performance.



# Easy-to-Use Evaluation System

Evaluating the LTC2380-24 is made easy with the DC2289 demonstration board. The DC2289 demonstrates correct layout and recommended device selection to achieve the highest performance design. Connect the DC2289 to the DC590 or DC2026 QuikEval™ and DC890 PScope™ data collection boards for use with our free data acquisition and analysis tools.

## QuikEval

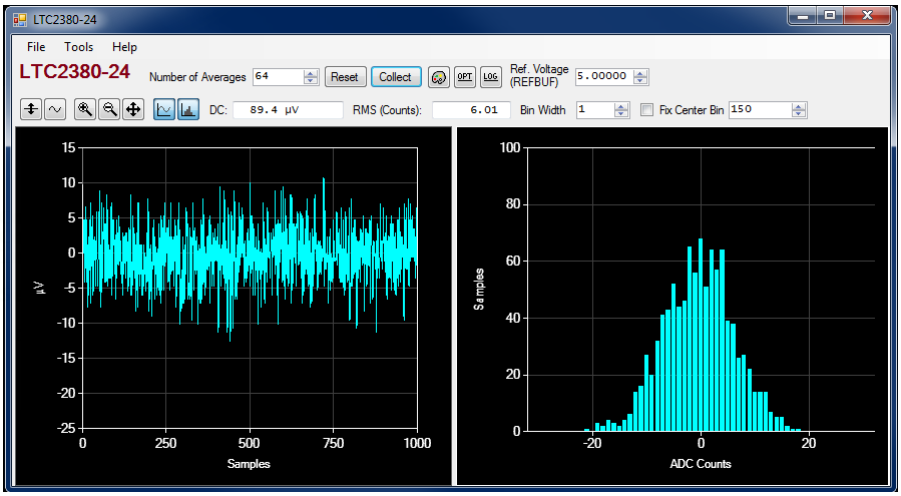
Use the QuikEval system with the DC590 or the DC2026 Linduino™ One controller board to demonstrate DC performance such as peak-to-peak noise and DC linearity for any selected number of averages. The DC2026 can also be used to evaluate the provided C++ code libraries, saving design time.

```
#ifndef LTC2380_CNV
#define LTC2380_CNV QUIKEVAL_CS
#endif

void setup()
{
  quikeval_SPI_init();
  quikeval_SPI_connect();
  Serial.begin(115200);

  DDRB = DDRB | B00000100;

  Serial.print("Press enter to begi
  while(!Serial.available());
  read_int();
}
```




## PScope

Use the PScope data collection system with the DC890 to achieve precise sampling rates or to demonstrate AC performance such as SNR, THD, SINAD and SFDR.