

# DESIGN NOTES

## LTC1390: A Versatile 8-Channel Multiplexer – Design Note 112

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### Introduction

Available in either 16-pin DIP or narrow body SOIC packages, the CMOS LTC<sup>®</sup>1390 is a high performance 8-to-1 analog multiplexer. It is addressed through a 3-wire digital interface featuring bidirectional serial data.

The LTC1390 features a typical on-resistance of 45 $\Omega$ , typical switch leakage of 50pA and guaranteed break-before-make switch operation. Charge injection is  $\pm 10$ pC (max). All digital inputs remain logic compatible whether operating on single or dual supplies. The inputs are robust, easily withstanding 100mA fault currents. The

LTC1390 operates over a wide power supply voltage range of 3V to  $\pm 15$ V.

### Low Power, Daisy-Chain Serial Interface, 8-Channel A/D System

Figure 1 shows the LTC1390 connected to the LTC1286 12-bit micropower A/D converter. The Clock (CLK) and Chip Select ( $\overline{CS}$ ) signals are connected in parallel to the LTC1390 and LTC1286. Both the LTC1390 and the LTC1286 are designed for serial data transfer. The LTC1390 also includes provisions for daisy-chain operation. This

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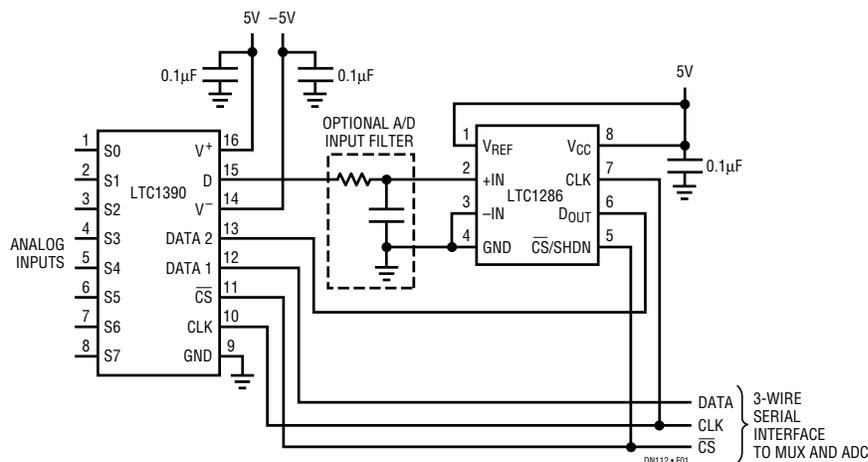


Figure 1. The LTC1390 Expands the 12-Bit Micropower LTC1286 ADC Input Capacity to Eight Channels

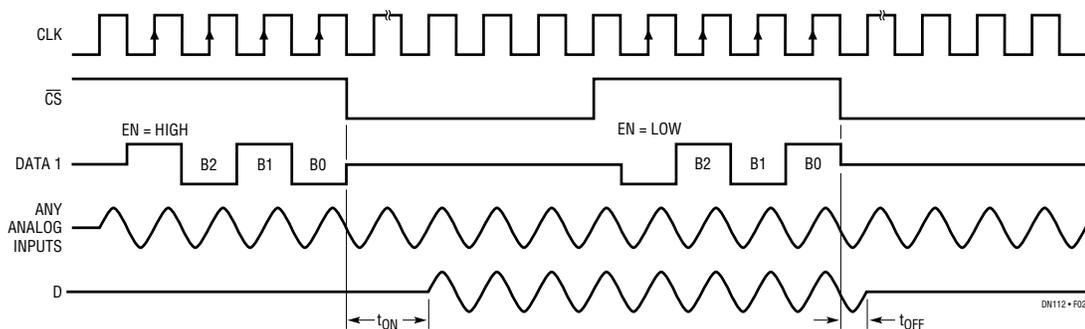


Figure 2. The LTC1390 Clocks in Data While  $\overline{CS}$  is High and Latches the Data, Enabling the Selected Channel, When  $\overline{CS}$  Goes low

allows full bidirectional communication over a single serial data line. While  $\overline{CS}$  is high the LTC1286 is inactive. The serial data used to select a multiplexer channel is applied to the LTC1390 DATA 1 input. Four bits are clocked into the LTC1390. The LTC1286  $D_{OUT}$  is in a high impedance state, ignoring these bits. The LTC1390 latches the four data bits when the  $\overline{CS}$  signal goes low, selecting a channel and initiating an A/D conversion from the LTC1286. Subsequent clock cycles shift out LTC1286 conversion data through the LTC1390 (from DATA 1 to DATA 2) to a host microprocessor. Figure 2 shows the LTC1390 timing diagram.

It is very easy to expand the width of the multiplexer and take advantage of the LTC1390 daisy-chain capability. Figure 3 shows the simple connections needed to add multiplexer channels. The Data 2 on each additional LTC1390 is connected to the Data 1 on the preceding LTC1390. When operating with multiple LTC1390s, the channel selecting data is sent in groups of four bits.

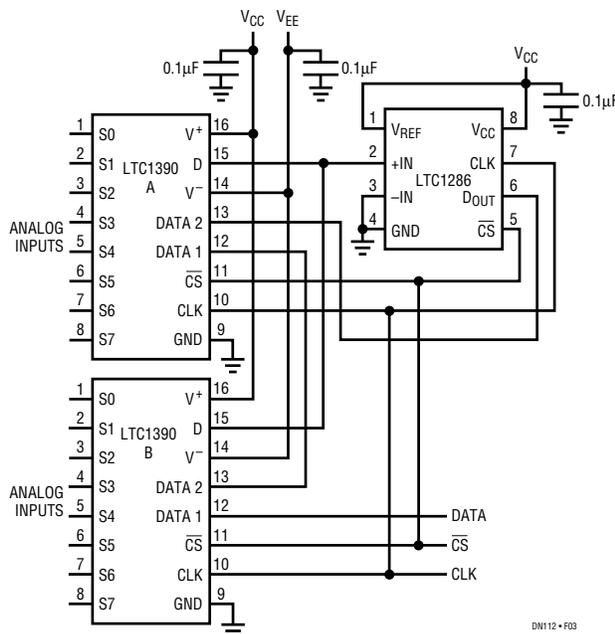
Another useful feature of the LTC1390 is the ability to add analog signal processing between the LTC1390 output and an A/D input. This helps save overall system cost because only one signal processing circuit is needed instead of one circuit per multiplexer input channel.

Figure 4 shows an active 2nd order lowpass filter connected between the LTC1390 output and the LTC1286 input. The heart of the lowpass filter is the single supply

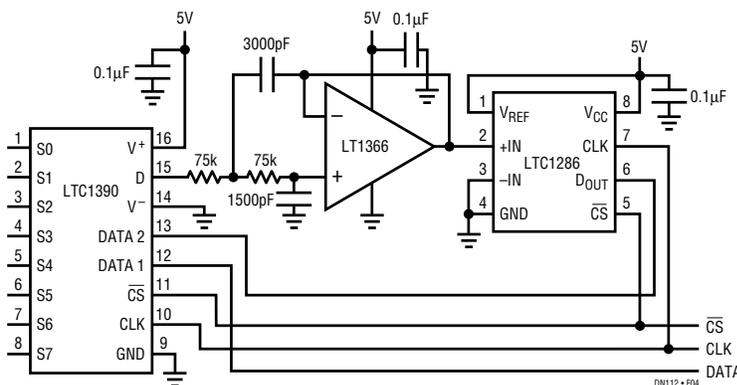
rail-to-rail precision LT<sup>®</sup>1366 operational amplifier. The filter's cutoff frequency is set to 1kHz.

### Conclusion

The LTC1390 provides designers of a serially interfaced data acquisition system with a flexible, low power and cost-effective way to expand the number of A/D channels.



**Figure 3. Additional Multiplexer Channels Are Easy to Add Without Adding Additional Serial Lines**



**Figure 4. The Connection Between the LTC1390 Output and the LTC1286 Input Is the Perfect Place for Signal Conditioning Circuits Such as the LT1366-Based 2nd Order Active Lowpass Filter**

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