Power Blanking for Increased Accuracy Using *iso*Power Devices

IDEA IN BRIEF

isoPower® devices can be used to accept blanking signals and use them to control the negative effects of switching noise on high precision measurements and thereby increase measurement accuracy.

Many sensor interface applications require signal and power isolation. Power is needed to run the analog-to-digital converter (ADC), provide sensor bias, and run the digital signal isolation; however, high precision measurements can be affected by switching noise from an isolated power supply. For example, the ADuM5201 *iso*Power coupler creates 360 MHz of noise when its tank circuit is active. If that noise coincides with the sample time of an ADC, the measurement loses some fidelity due to noise coupling into the sensor bias, the ADC supply, or the reference. To minimize interference, it has been a common practice in digital systems to start ADC conversions between clock edges to ensure that switching noise does not interact with the voltage conversion.

*iso*Power products operate by running a high-current tank oscillator into an internal microtransformer. Power is coupled to the secondary where it is rectified and smoothed. The secondary side regulates the output voltage by creating a PWM style signal that is sent back to the primary side with an *i*Coupler® data channel, gating the tank oscillator off and on based on the secondary side power and voltage needs. Several of the ADI *iso*Power devices allow the tank circuit to be directly controlled by external pins, allowing multiple *iso*Power devices to be controlled by a common PWM signal. This feature can be used to exclude tank circuit noise when the ADC is making high fidelity conversions.

The ADuM520x, ADuM620x, ADuM5000, and ADuM6000, are capable of becoming slaves to an external master controller. The control lines that allow this functionality can be used to accept a BLANK signal that disables the tank circuit. Two control lines are used: RC_{IN} and RC_{SEL}.
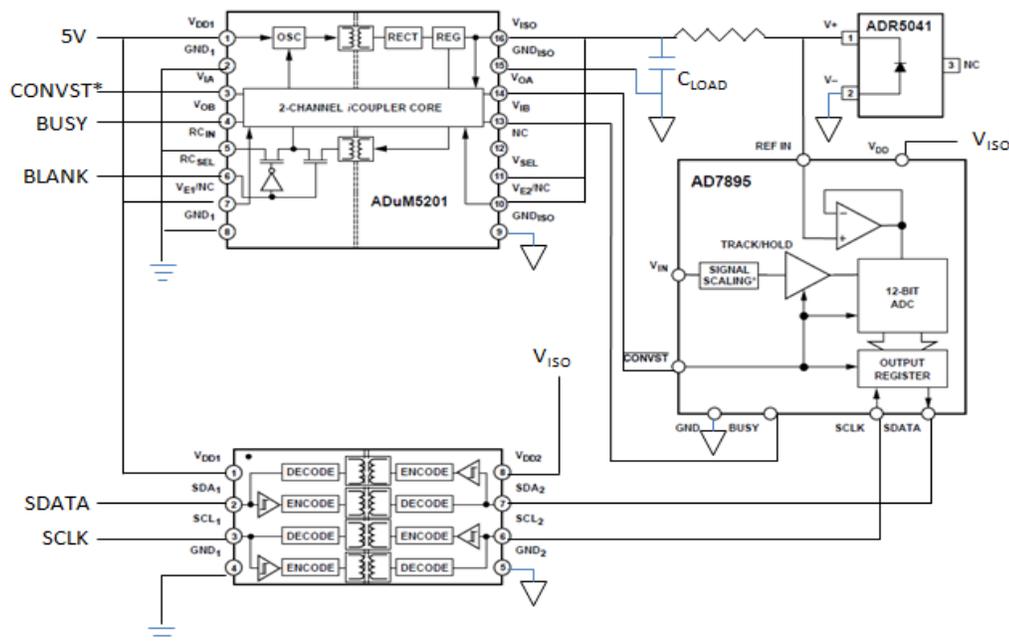

Figure 1. Isolated Low Noise ADC Circuit

RC_{SEL} chooses the source of the tank control circuit, either a PWM signal derived from the regulation circuit on the secondary side or the signal presented to RC_{IN}. If the RC_{IN} line is tied low, the effect of RC_{SEL} is to choose between regulation by the secondary side controller or forcing the oscillator off.

When the oscillator is off, the output voltage decreases at a rate determined by the load (equivalent resistance R_{LOAD}) and the value of the bulk capacitance (C_{LOAD}) on V_{ISO}, giving an $R_{LOAD} \times C_{LOAD}$ time constant to the voltage sag. When the RC_{SEL} signal is returned to high, V_{ISO} is driven back to the regulation setpoint by the control loop.

The circuit in Figure 1 is constructed around an AD7896 12-bit ADC with an I²C data interface and illustrates the important features of the technique. The circuit is shown without many of the passive components such as bypass capacitors and pull-up resistors for simplicity, but these components must be added appropriately for a complete schematic. The device communicates to the controller with an I²C interface; therefore, an ADuM1250 is used to isolate the data communications. An ADuM5201 is used to provide power and isolate the convert start and busy signals for the ADC.

The conversion starts when the CONVST signal goes low for $t_1 = 40$ ns (see Figure 2). The BUSY signal goes high during the conversion for about 4 μs, indicating that the data is not yet ready for transfer. The BUSY line returns to low, and data can be clocked out with the SCLK line of the I²C bus.

Power from the ADuM5201 is blanked by pulling the RC_{SEL} pin low with the BLANK signal. It takes about 100 ns for the power oscillator to turn off when it is active; therefore, the BLANK signal is applied with $t_0 > 100$ ns to ensure that the output power is quiet. It can be held off as long as the particular ACD requires for highest precision conversion. In this example, the power is held off until after the BUSY signal returns to low.

The effect of the BLANK signal is shown in Figure 3 where the tank circuit noise can be clearly seen before the BLANK signal is applied and is turned off approximately 100 ns afterward.
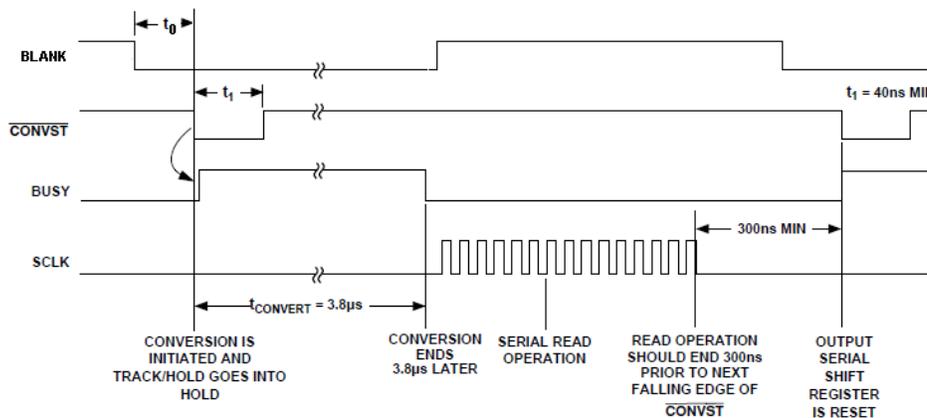

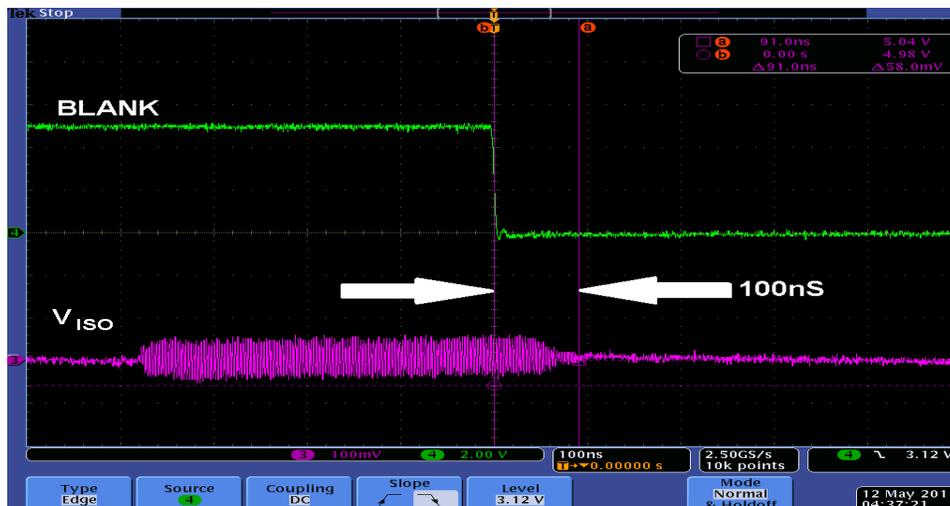*Figure 2. System Timing Diagram*

Figure 3. Delay from the BLANK Pulse to the End of the Power Supply Noise

Figure 4. Full Operation with a 10 mA Load and 24 mV Supply Sag Due to the BLANK Pulse

An entire cycle of blanking for the *iso*Power device is shown in Figure 4. This data was taken with a 5 μs blanking pulse, a 10 mA load, and C_{LOAD} = 10 μF. The important features are the periodic tank oscillator noise, which comes at approximately a 600 kHz rate, the standard ripple between each oscillator burst, and the output sag due to the blanking pulse. The output voltage sag due to the 5 μs BLANK pulse is only 24 mV in this example, only a few times the standard ripple in the output and insignificant to the ADC measurements being taken. The *iso*Power device recovers to its output setpoint in approximately 20 μs, and the system is ready for its next measurement. This method is flexible and easily adapted to many timing requirements by simply adjusting the value of C_{LOAD} to keep voltage sag at the desired level as load and blanking times change, allowing measurements to be taken at the accuracy limit of the ADC.

I^2C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors).

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