WAN_0224

WM8224 DC Drift Using Voltage Follower

INTRODUCTION

The WM8224 is an analogue front end (AFE) digitiser that can be used with CCD (Charge Coupled Device) or CIS (Contact Image Sensor) sensors to capture the analogue video signal for digital processing. The sensor output signal can be ac or dc coupled to the WM8224.

For CCD type input signals, containing a fixed reference/reset level, the signal may be processed using Correlated Double Sampling (CDS), which will remove pixel-by-pixel common mode noise. With CDS processing the input waveform is sampled at two different points in time for each pixel, once during the reference/reset level and once during the video level.

In situations where the input video signal does not have a stable reference level it may be necessary to clamp only during those pixels which have a known state (e.g. the dummy, or "black" pixels at the start or end of a line on most image sensors). This is known as line-clamping and relies on the input capacitor to hold the DC level between clamp intervals.

In non-CDS mode this can be done directly by controlling the RSMP input pin to go high during the black pixels only. The dc voltage after the ac coupling capacitor depends on the length of time the capacitor is charged/discharged (length of RSMP and the number of dummy pixels used), the value of capacitance, the voltage applied and the resistance in the circuit.

If the input signal is ac coupled and line clamping is used, then to minimise code drift, the internal input voltage buffers should be enabled to minimise the dc drift in the input signal.

This document shows the advantages of using the voltage followers to minimise the effect of the code drift when using line clamping.

MEASUREMENT SETUP

The test setup to measure the dc drift when using an ac coupled input signal and operating the WM8224 in non-CDS mode with line clamping, as with CIS sensor signals, is described in this section.

The connection of the sensor to the WM8224 is shown in Figure 1.

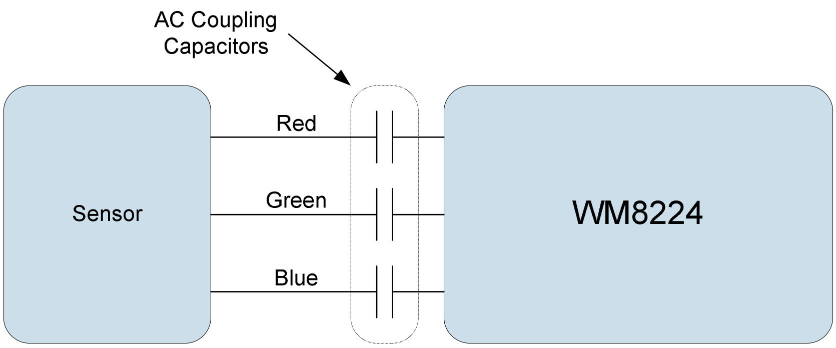

Figure 1 AC Coupled Connection of Sensor to WM8224

Only one channel will be discussed as all channels behave the same. In this case the Red channel was used for the measurement.

The output voltage from the sensor is applied to the ac coupling capacitor. The Reset Level Clamp (RLC) circuit is used to clamp the WM8224 side of this capacitor to the VRLC voltage during the black pixels (line clamping). In order for clamping to produce correct results the input voltage during the clamping must be a constant value.

The input clamping sets the input to the WM8224 at the correct dc level (VRLC) for processing. The dc level at the RINP input must be held as constant as possible to minimise the code drift at the output. Enabling the voltage followers in the WM8224 will minimise the drift.

Test conditions:

VRLC = 1.57V

MCLK = 40MHz

AC coupling capacitors = 39pF

Input voltage = 2V

RESULTS

This section presents the results showing the effect of enabling the voltage follower on the input signal voltage and on the output codes from the WM8224. A dc voltage has been applied which more easily shows the drift effect.

The plot in Figure 2 show the input signal voltage from the sensor at the RINP pin, after the ac coupling, with the voltage follower disabled. The effect is the same for the other channels (GINP, BINP).

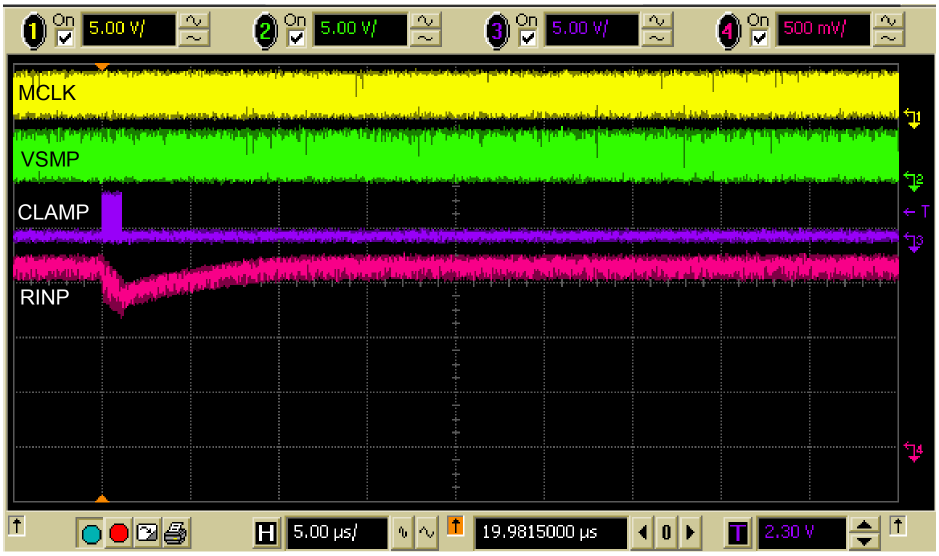

Figure 2 Oscilloscope Trace at RINP with Voltage Follower DISABLED

During the clamping at the start of the line, the ac coupling capacitor voltage at the input pin (RINP) of the WM8224 is discharged during the RSMP pulse period towards the VRLC voltage. In this case there are 45 RSMP pulses. These RSMP pulses would normally occur during the black pixels at the start of the line.

After the clamp has set the dc voltage for the following measurements the voltage should be held throughout the line period. As shown by Figure 2, the voltage at the RINP pin on the WM8224 drifts back up towards the sensor output signal dc voltage. This will cause the output codes to change.

When the voltage followers are enabled the input voltage at the RINP does not drift up to the sensor output voltage but stays clamped at a near constant voltage. The results are shown in Figure 3.

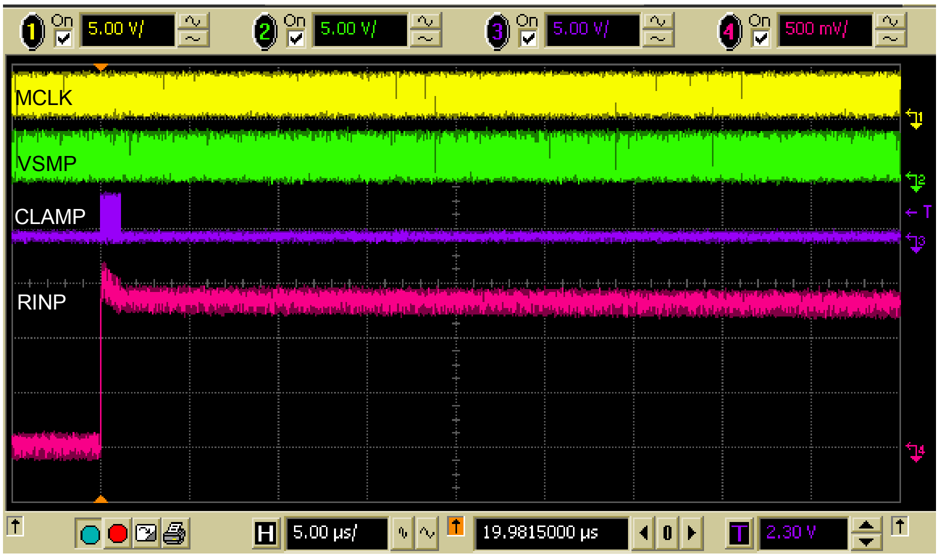

Figure 3 Oscilloscope Trace at RINP with Voltage Follower ENABLED

The value held after the clamp period will start to drift but very much slower than when the voltage followers are disabled. Figure 4 shows the drift using a 500us/div time base (100 times longer than the time base used in Figure 2 and Figure 3).

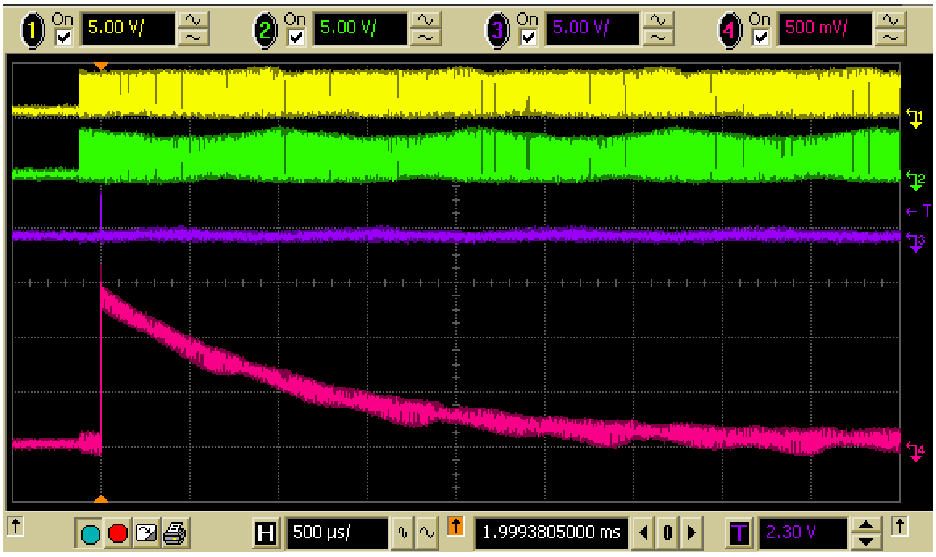

Figure 4 Oscilloscope Trace at RINP with Voltage Follower ENABLED

Note that the low frequency noise present on the zoomed out trace is caused by the oscilloscope at large time base settings.

The output codes from the WM8224 taken over 32767 samples are shown in Figure 5.

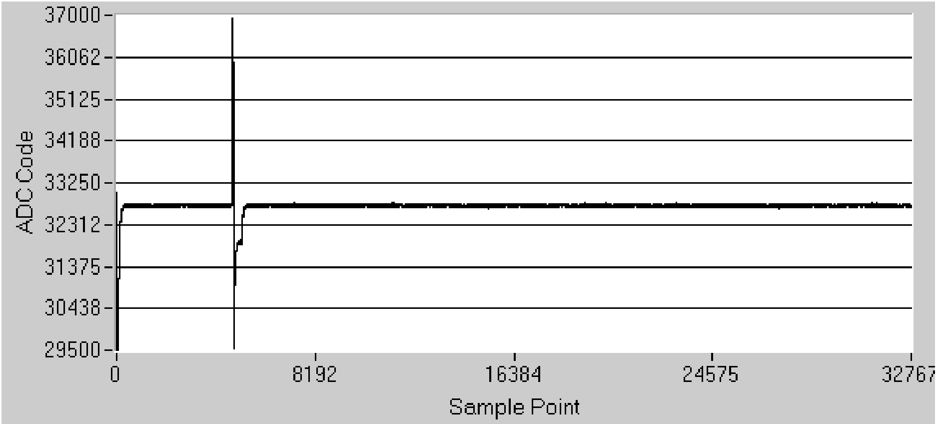

Figure 5 Output Code with Voltage Follower DISABLED

When the voltage followers are enabled, the output codes stay approximately constant as shown in Figure 6.

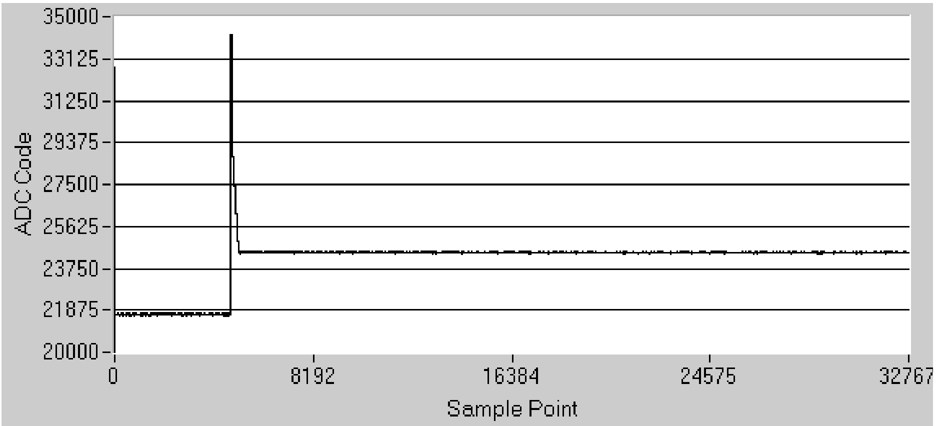

Figure 6 Output Code with Voltage Follower ENABLED

CAPACITOR VALUE CALCULATION

The amount of drift at the input RINP is dependant on the size of the ac coupling capacitor used. Larger values of ac coupling capacitor give less drift.

Example

The line period is 850us and the drift should be <1mV. What value of ac coupling capacitor should be used?

$i = C \cdot dv / dt$

From this it is possible to calculate the value for the ac coupling capacitor C.

$C = i \cdot dt / dv$

The leakage current for the WM8224 is 12nA, dv = 1mV, and dt = 850us.

Calculating the value for C gives a minimum capacitor value of 10nF.

SUMMARY/CONCLUSION

This document has shown that in the non-CDS mode using ac coupled input signals, such as from CIS sensors, the use of the input voltage followers will minimise the code drift when line clamping is used.

APPLICATION SUPPORT

If you require more information or require technical support, please contact the Wolfson Microelectronics Applications group through the following channels:

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