Technical Note

MT9M131

Bayer Output Modes

Introduction

This technical note provides additional details concerning the output modes of the MT9M131. In the MT9M131 sensor, the default output mode is YCbCr for both context A and context B. The customer has the option to program the output to be RGB or to bypass the image flow processor (IFP) and output Bayer data directly.

There are three raw Bayer output modes:

- Bayer 8+2
- Bayer 10 (raw Bayer)
- Bayer 8 (Processed Bayer)

This technical note explains how to program these modes and the effective data rate of each mode.

Bayer 8+2

In Bayer 8+2 mode, the entire image processing flow is bypassed and raw Bayer data is output directly. The image data passes through the camera interface and the 10 bits are formatted to two output bytes through the camera interface.

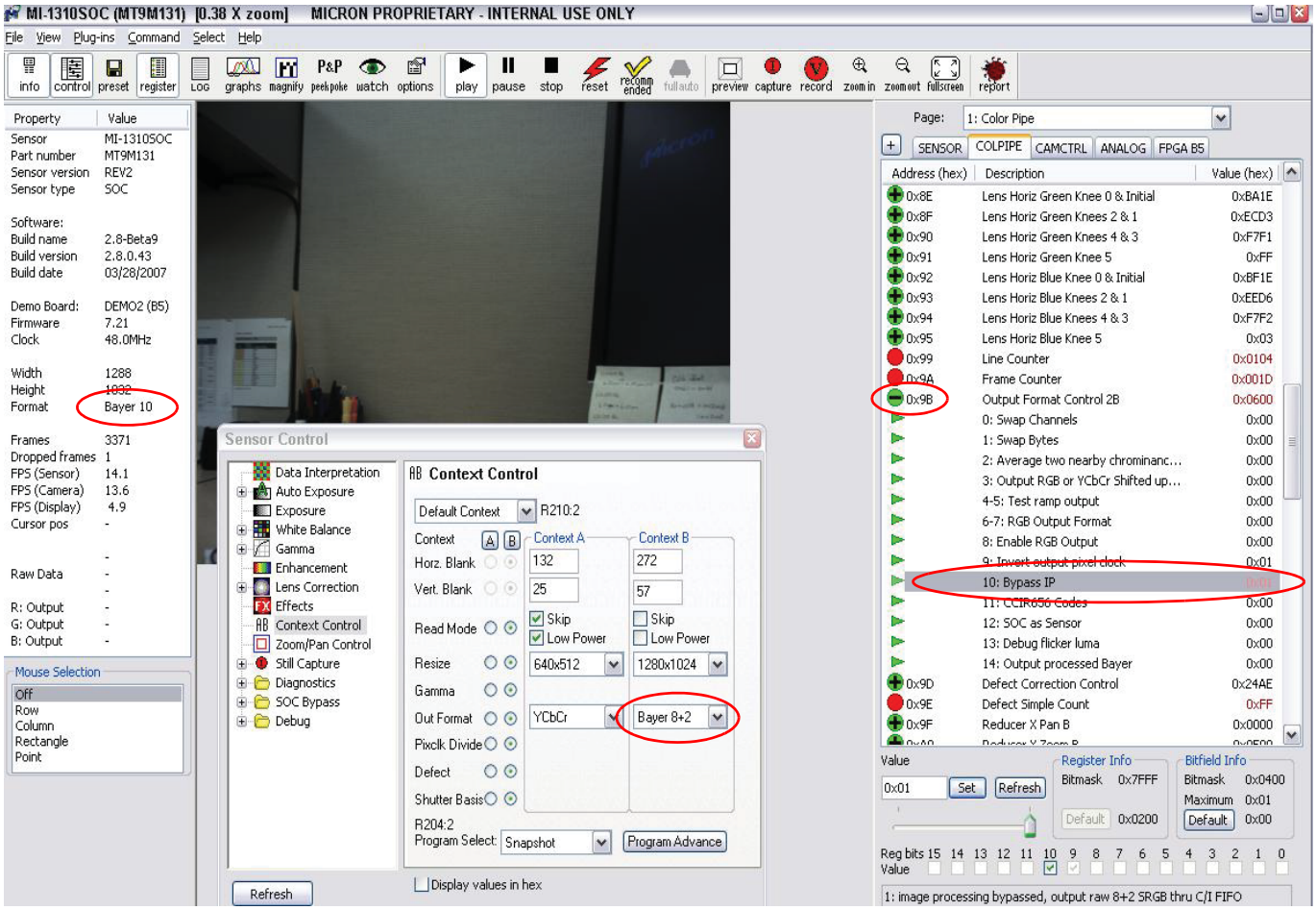
To program MT9M131 to output Bayer 8+2:

- Set R0x13A[10] = 1 for context A // bypass the IFP
- Set R0x19B[10] = 1 for context B // bypass the IFP

Figure 1 on page 2 shows that when R0x19B[10] is set to "1," the Bayer 8+2 output is programmed to be output in context B. The sensor control window (center) and the output format is updated to Bayer 8+2.

Note: In Figure 1 on page 2 the information window (on the left) shows Bayer 10 for Bayer 8+2.

Figure 1: Bayer 8+2 in DevWare



In Bayer 8+2 mode, each pixel has 2 bytes of data, which can be seen in Table 1. The first byte of pixel has 8 bits and the second byte has only 2 valid bits of data.

Table 1: Bayer 10 Output Data Order

Mode	Byte	DOUT7	DOUT6	DOUT5	DOUT4	DOUT3	DOUT2	DOUT1	DOUT0
Bayer 8+2	First	B9	B8	B7	B6	B5	B4	B3	B2
	Second	0	0	0	0	0	0	B1	B0

Figure 2 and Figure 3 on page 4 show the scope captures of pixel clock (PIXCLK) and LINE_VALID (LV) signals with input clock (CLKIN) at 48 MHz. Each byte is outputting at 48 MHz; however, the effective data rate is 24 Mp/s because each pixel is 2 bytes.

Figure 2: Bayer 8+2 on Scope

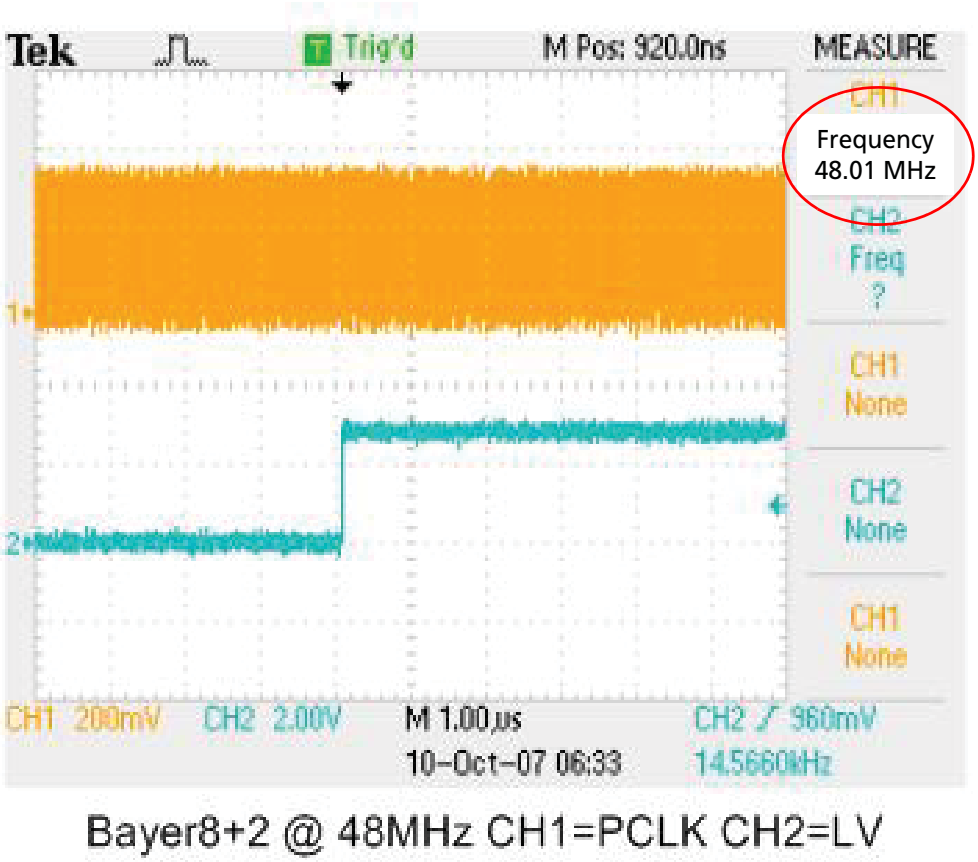
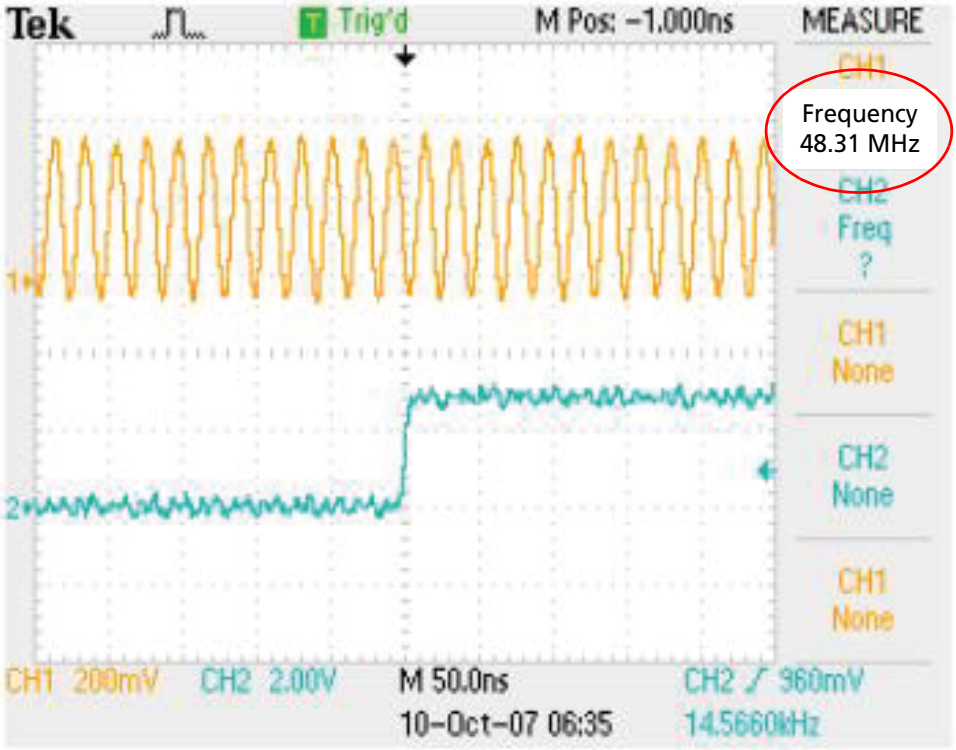


Figure 3: Bayer 8+2 on Scope



Bayer8+2 @ 48MHz CH1=PCLK CH2=LV

Bayer 10 (Raw Bayer)

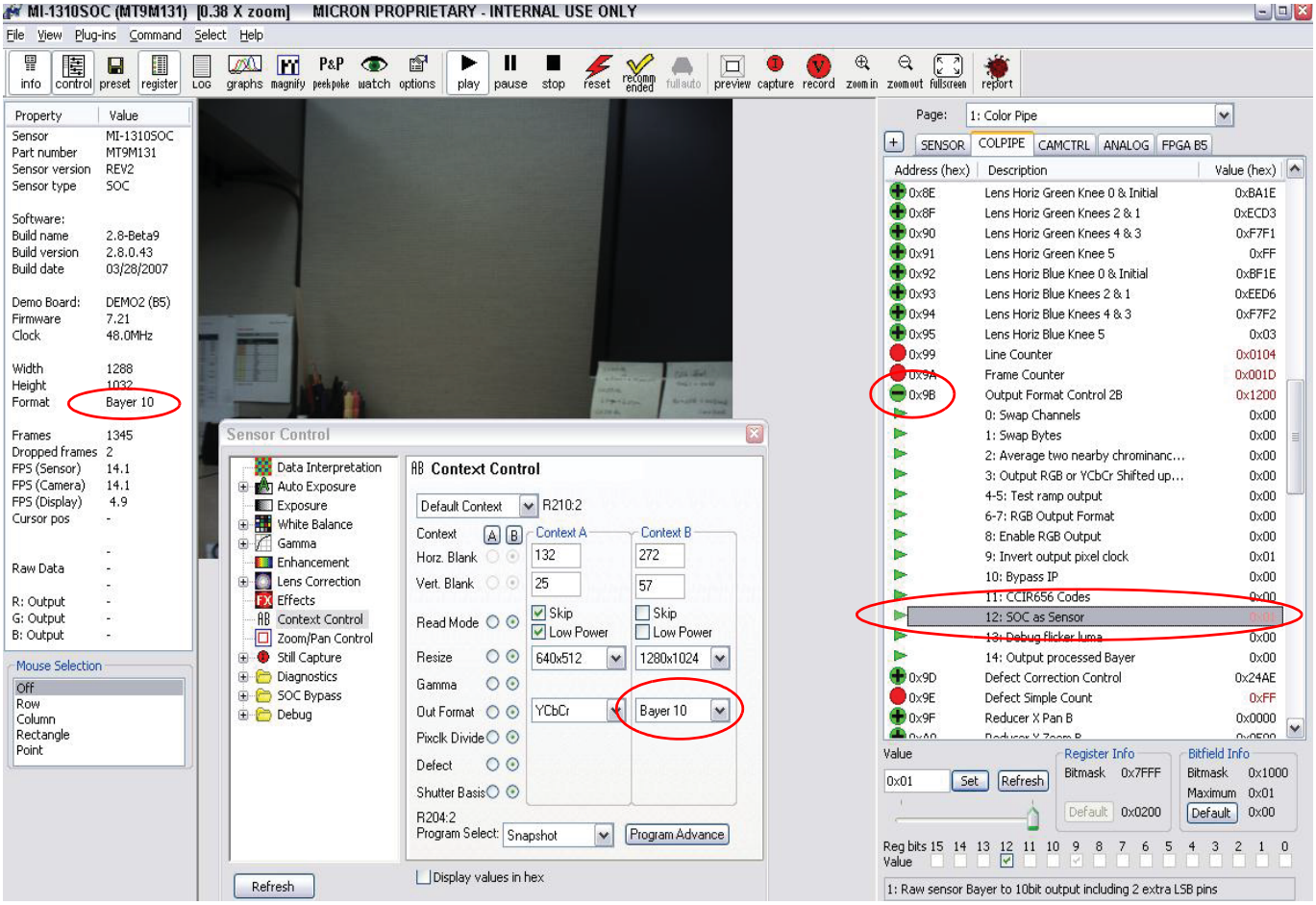
In Bayer 10 mode, the sensor output is coupled directly to the SOC camera port, including two extra LSB signals to provide the full 10-bit sensor output. Bits [9:2] of the sensor output are mapped to DOUT[7:0]. Bits [1:0] of the sensor output are mapped to DOUT_LSB[1] and DOUT_LSB[0].

To program MT9M131 to output Bayer 10:

- Set R0x13A[12] = 1 for context A // SOC as sensor
- Set R0x19B[12] = 1 for context B // SOC as sensor

Figure 4 shows that when R0x19B[12] is set to "1," Bayer 10 output is programmed to output in context B. The information window, sensor control window, and the output formats are updated to Bayer 10.

Figure 4: Bayer 10 in DevWare



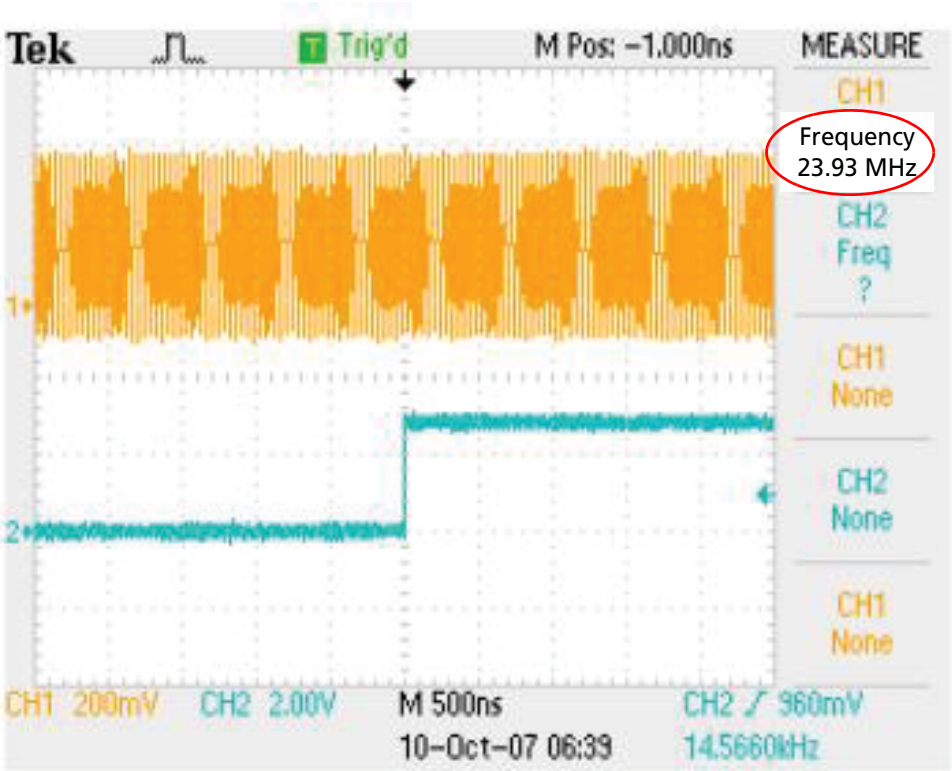
In Bayer 10 mode, each pixel takes up 1 byte (8 bits) plus 2 bits from LSB1 and LSB0 pads. This is only available in the CLCC package. The output data order is shown in Table 2.

Table 2: Bayer 10 Output Data Order

Mode	DOUT7	DOUT6	DOUT5	DOUT4	DOUT3	DOUT2	DOUT1	DOUT0	LSB1	LSB0
Bayer10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0

Figure 5 and Figure 6 on page 7 are the scope captures of the pixel clock (PIXCLK) and LV signals with the input clock (CLKIN) at 48 MHz. PIXCLK is running at 24 MHz, so the effective data rate is 24 Mp/s because each pixel is only 1 byte plus 2 hardwired bits from LSB1 and LSB0.

Figure 5: Bayer 10 on Scope



Bayer10 @ 48MHz CH1=PCLK CH2=LV

Figure 6: Bayer 10 on Scope

Bayer10 @ 48MHz CH1=PCLK CH2=LV

Bayer 8 (Processed Bayer)

Processed Bayer is Bayer format data regenerated from processed RGB data. Processed RGB data is resampled to reduce the data rate by half. Each 16-bit RGB pixel is converted to the 8-bit value of one of the colors: R, G, or B.

To program MT9M131 to output Bayer 8, set:

For context A:

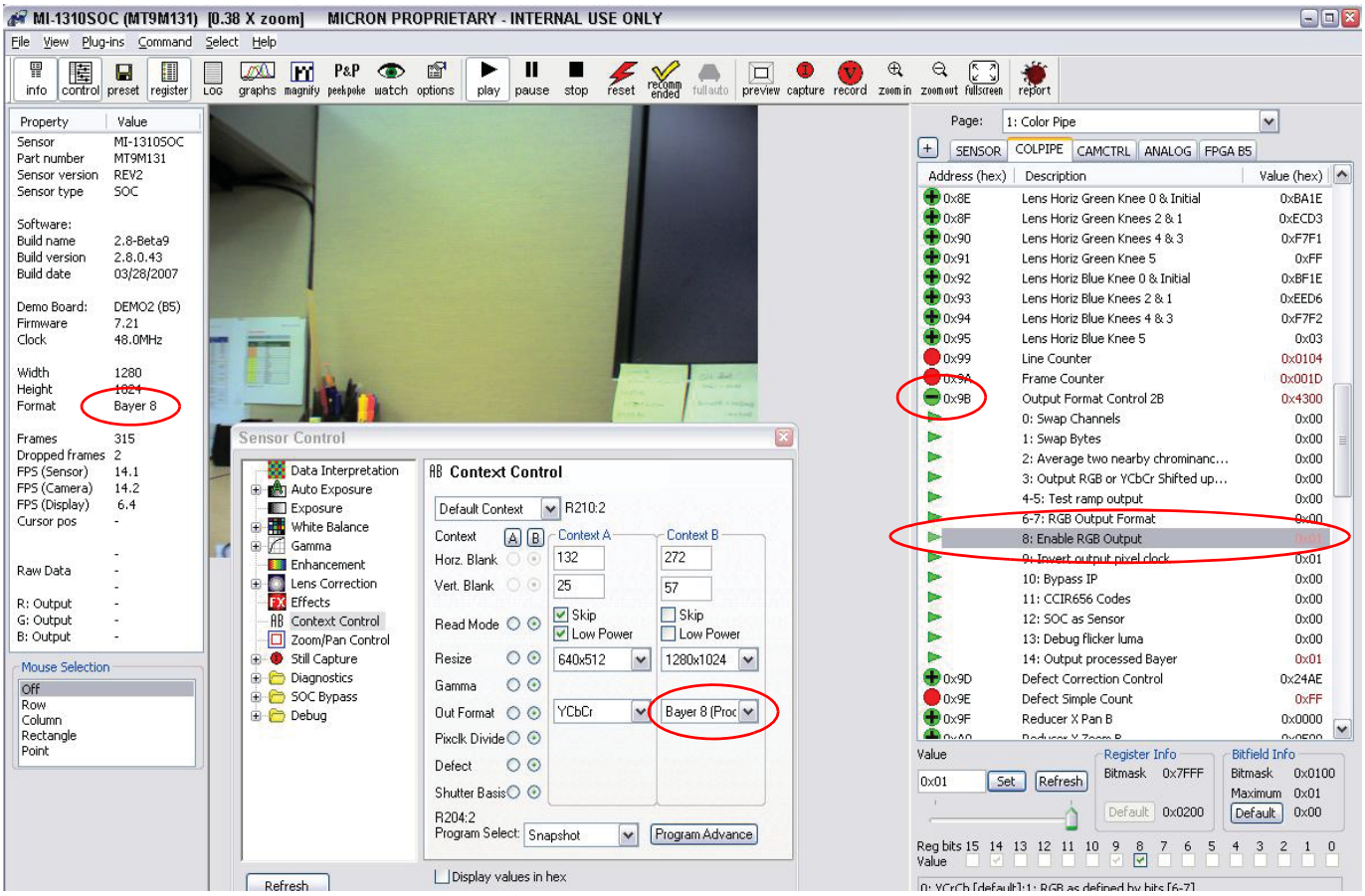
- Set R0x13A[14] = 1 // output processed Bayer
- Set R0x13A[8] = 1 // output RGB data

For context B:

- Set R0x19B[14] = 1 // output processed Bayer
- Set R0x19B[8] = 1 // output RGB data

Figure 7 shows that when R0x19B[14] and R0x19B[8] are set to "1," Bayer 8 output is programmed to output in context B. The information window, sensor control window, and the output formats are updated to Bayer 8.

Figure 7: Bayer 8 (Processed Bayer) in DevWare



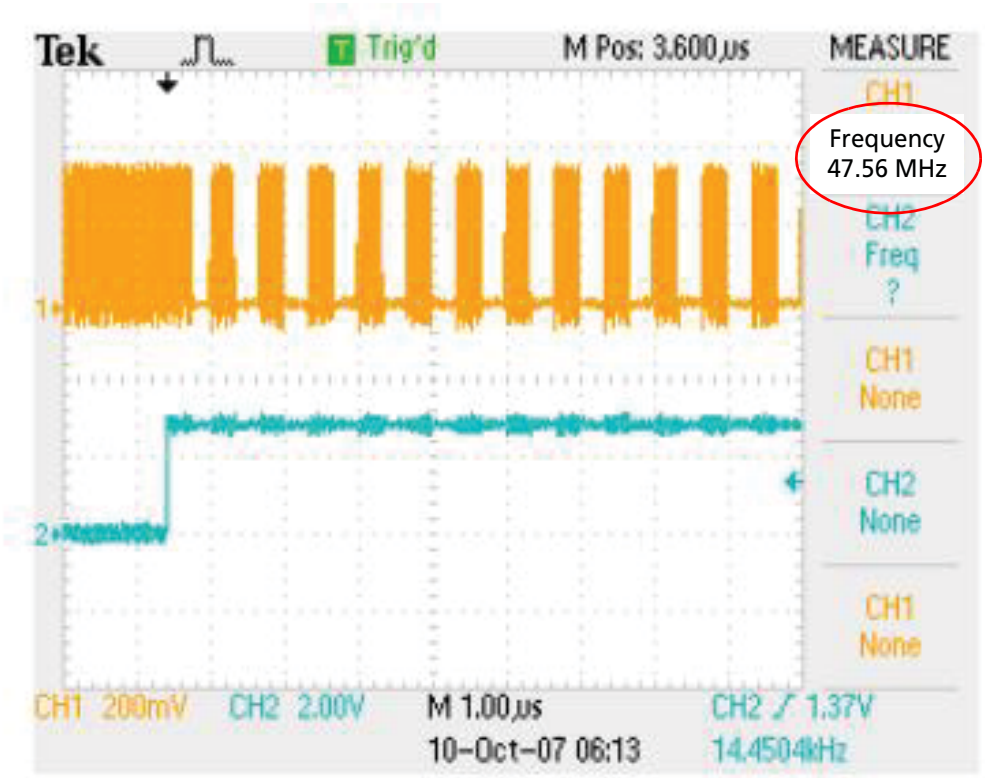
In Bayer 8 (Processed Bayer) mode, each pixel is one byte long. The output data ordering is shown in Table 3.

Table 3: Bayer 8 (Processed Bayer) Output Data Order

Mode	DOUT7	DOUT6	DOUT5	DOUT4	DOUT3	DOUT2	DOUT1	DOUT0
Bayer 8	B7	B6	B5	B4	B3	B2	B1	B0

Figure 8 through Figure 10 on page 11 are the scope captures of PIXCLK and LV signals with CLKIN at 48 MHz. Figure 9 on page 10 and Figure 10 on page 11 show the active period is 336ns, which equals the inactive period. Therefore, PIXCLK is bursting 16 pixels at 48 MHz, which makes the effective data rate 24 Mp/s.

Figure 8: Bayer 8 (Processed Bayer) on Scope



Bayer8 @ CLKIN=48MHz CH1=PCLK CH2=LV

Figure 9: Bayer 8 (Processed Bayer) on Scope

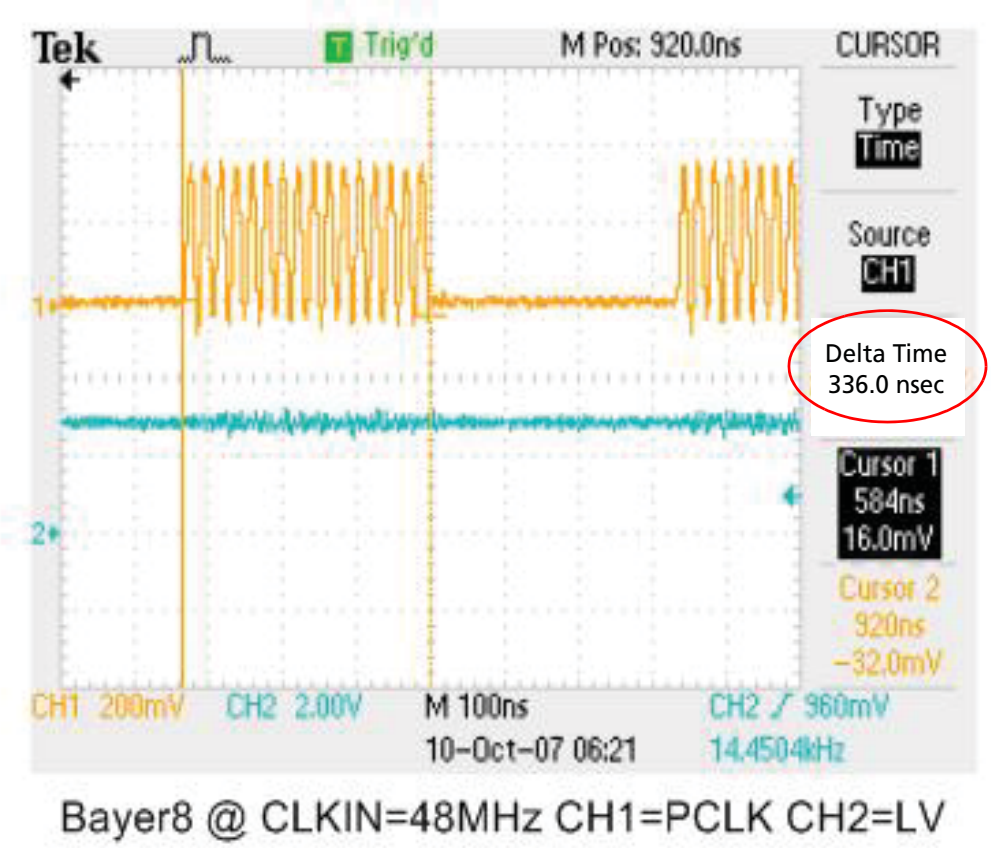
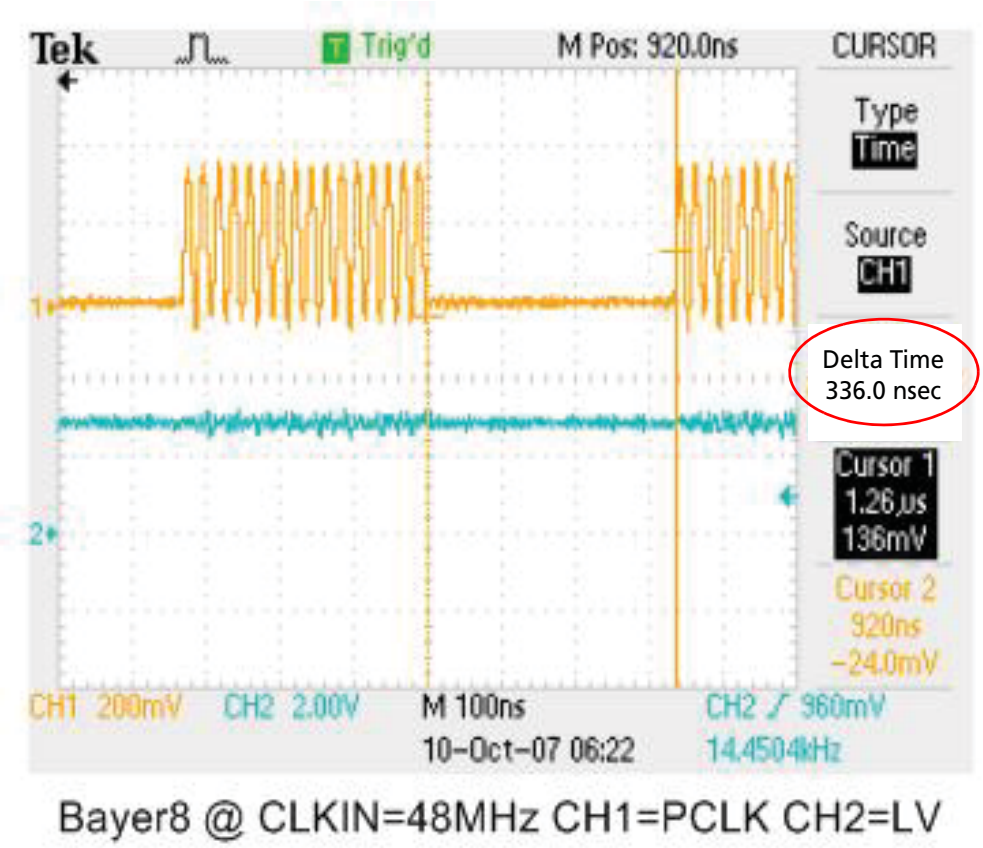


Figure 10: Bayer 8 (Processed Bayer) on Scope



Burst Versus Non-Burst Mode

Figure 8 on page 9 through Figure 10 on page 11 show that in Bayer 8 mode, the clock is output in a burst manner. The MT9M131 has an on-chip 352 x 16-bit FIFO, which converts it to a uniform clock (non-burst) when enabled.

Figure 11 shows that by setting R0x1B5 from 0x0101 to 0x0201, context B's divide ratio is set to "2." This will produce a uniform pixel clock, shown in Figure 12 on page 13, which makes the effective data rate 24 Mp/s.

Figure 11: Bayer 8 (Processed Bayer) – Non-Burst Output Setup in DevWare

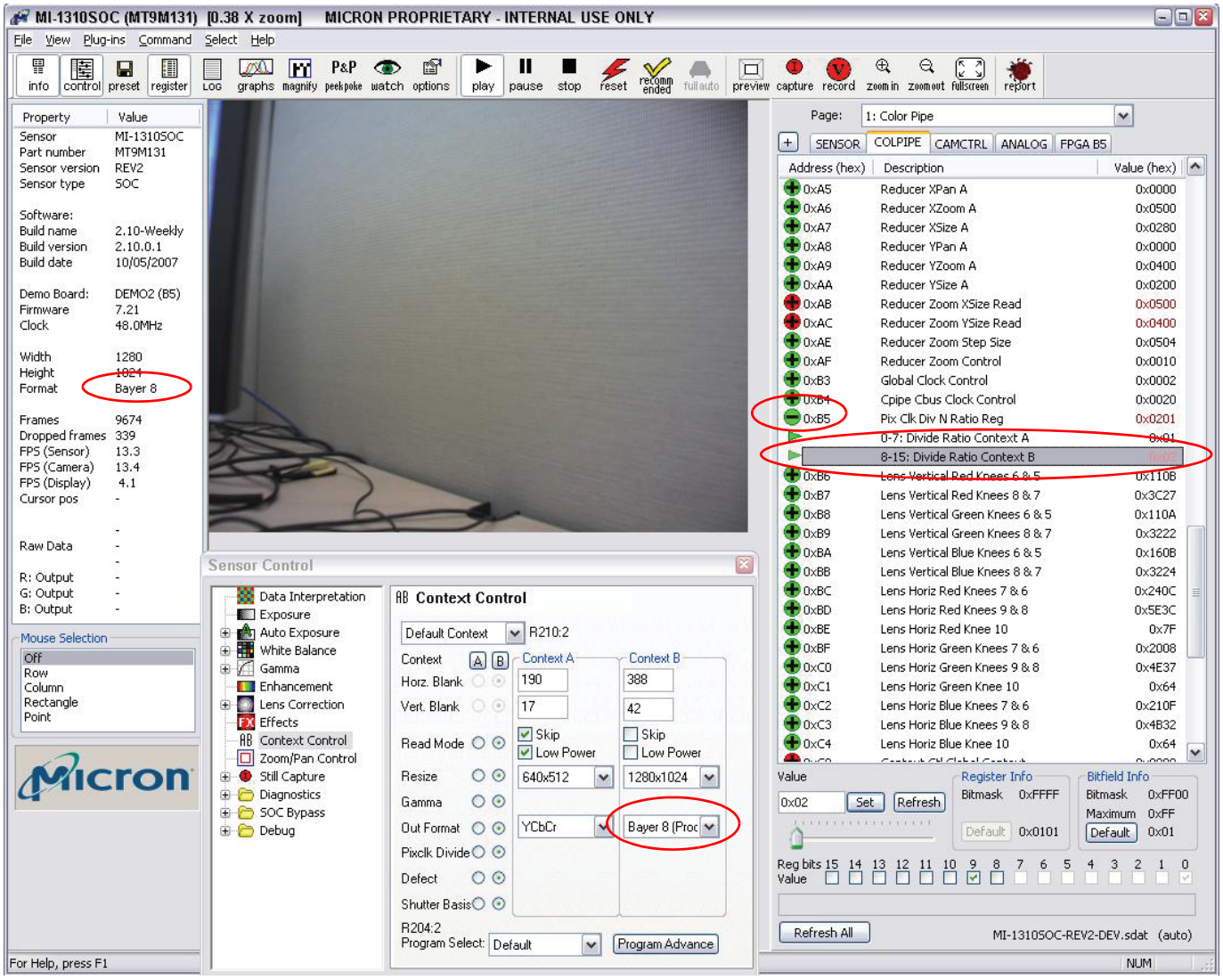
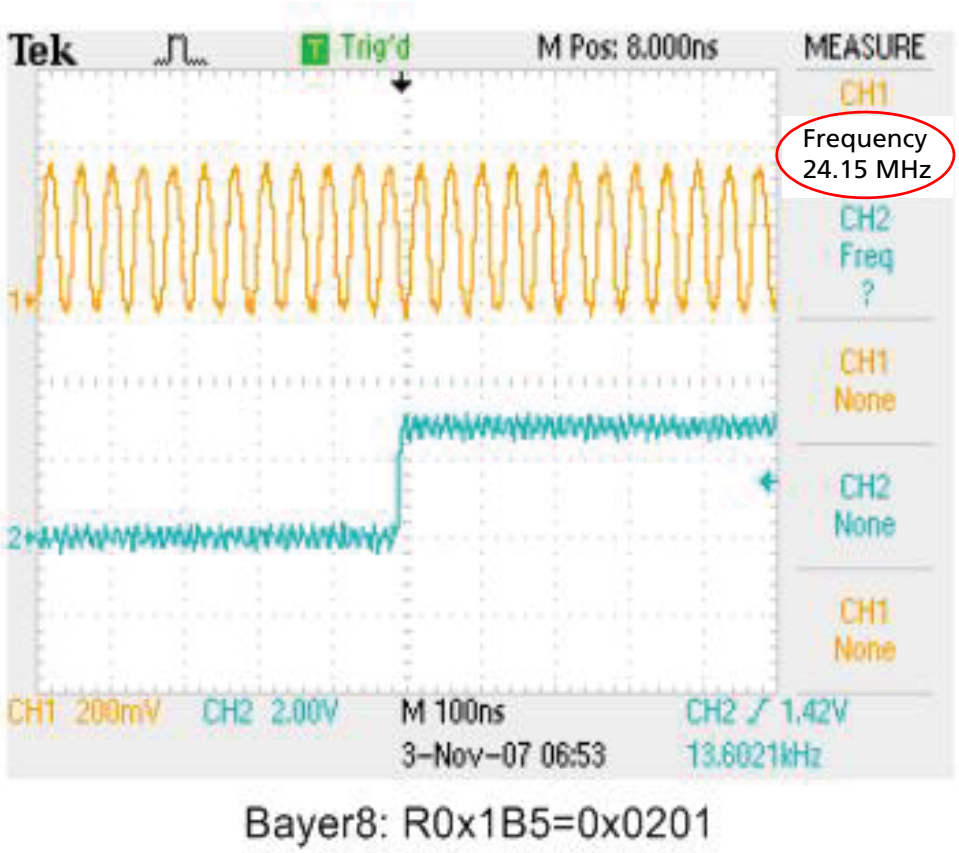


Figure 12: Bayer 8 (Processed Bayer) – Non-Burst Output on Scope



Conclusion

MT9M131 has three different Bayer output modes: Bayer 8+2, Bayer 10 (raw), and Bayer 8 (Processed Bayer). This technical note discusses how to program the different modes, the output data order of each mode, and demonstrates the effective data rate of each mode. For more information on this or other features, refer to the MT9M131 data sheet on Micron's Web site at www.micron.com/imaging.

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Revision History

Rev. A 11/29/2007

- Initial release