ArduCAM USB Camera Shield

Application Note for MT9F002

Rev 1.0, Aug 2017

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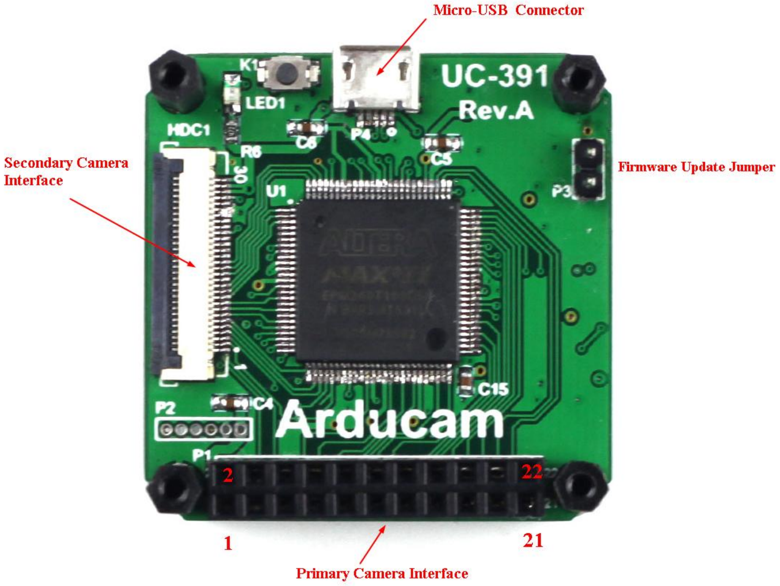
1 Introduction

This user guide describes the detail operation of ArduCAM USB camera for MT9F002. The latest deivce driver, SDK library and examples can be downloaded from the https://github.com/ArduCAM/ArduCAM_USB_Camera_Shield.

2 Hardware Installation



There are two different camera interface provided on the USB camera shield, but only one camera interface can be used at a time. The MT9F002 camera header board should be connected to the secondary camera interface and should align the pin 1 of the camera breakout board to the USB camera shield camera connector pin 1.

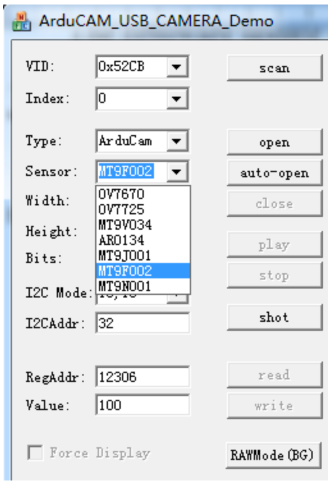
Table 1 HDC1 Connector Pin Definition

Pin No.	PIN NAME	TYPE	DESCRIPTION
1	GND	Ground	Power ground
2	FLASH	Input	Flash output control
3	Trigger	Output	Exposure synchronization input
4	VSYNC	Input	Active High: Frame Valid; indicates active frame
5	HREF	Input	Active High: Line/Data Valid; indicates active pixels
6	DOUT11	Input	Pixel Data Output 11 (MSB)
7	DOUT10	Input	Pixel Data Output 10
8	DOUT9	Input	Pixel Data Output 9
9	DOUT8	Input	Pixel Data Output 8
10	DOUT7	Input	Pixel Data Output 7
11	DOUT6	Input	Pixel Data Output 6
12	DOUT5	Input	Pixel Data Output 5
13	GND	Ground	Power ground
14	DOUT4	Input	Pixel Data Output 4
15	DOUT3	Input	Pixel Data Output 3
16	DOUT2	Input	Pixel Data Output 2
17	DOUT1	Input	Pixel Data Output 1
18	DOUT0	Input	Pixel Data Output 0(LSB)
19	XCLK	Output	Master Clock into Sensor
20	PCLK	Input	Pixel Clock output from sensor
21	SCL	Input	Two-Wire Serial Interface Clock
22	SDATA	Bi-directional	Two-Wire Serial Interface Data I/O
23	RST	Output	Sensor reset signal, active low
24	GND	Ground	Power ground
25	GND	Ground	Power ground
26	STANDBY	Output	Standby-mode enable pin (active HIGH)
27~30	VCC	POWER	3.3v Power supply

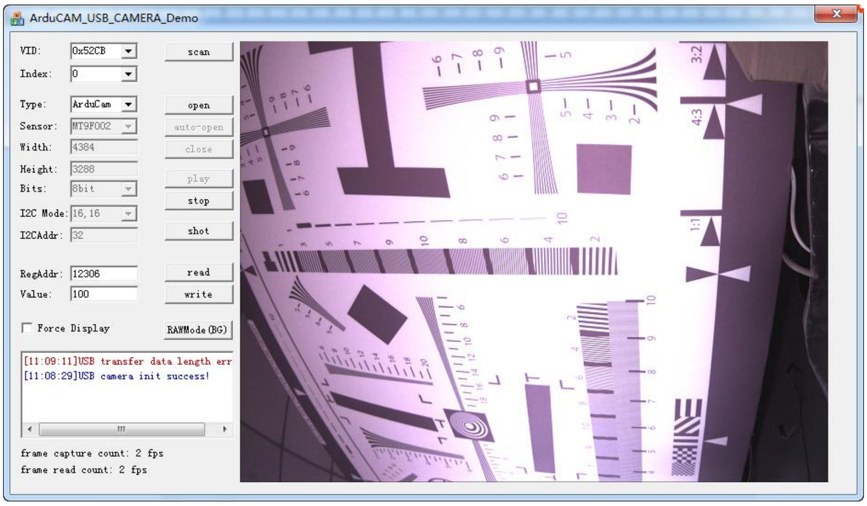
The firmware update jumper should be left open when normal operation.

3 Run the Demo

Plug in the USB cable to the camera and the host PC USB port, and open the Windows demo software. Select the MT9F002 from the Sensor drop down list then click auto-open button.



Click play button to run the camera in video mode.



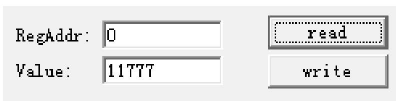
4 Tune the Sensor Registers

4.1 Identify the Sensor Version

Sensor register address 0x00 is read only, and always return the chip vision 0x2E01(11777) when read it.

Register Dec(Hex)	Name	Data Format (Binary)	Default Value Dec(Hex)
R0 (R0x0000)	model_id	dddd dddd dddd dddd	11777 (0x2E01)

Input the register address 0 in decimal to the RegAddr dialog box and click read button, the Value dialog box will show 11777in decimal which is identical to 0x2E01 in hex.



4.2 Adjust the Sensor Exposure

The integration (exposure) time of the MT9F002 is controlled by the fine_integration_time and coarse_integration_time registers.

The limits for the fine integration time are defined by:

$$fine\_integration\_time\_min \leq fine\_integration\_time \leq (line\_length\_pck - fine\_integration\_time\_max\_margin)$$

The limits for the coarse integration time are defined by:

$$coarse\_integration\_time\_min \leqslant coarse\_integration\_time$$

The actual integration time is given by:

$$integration\_time = \frac{((coarse\_integration\_time * line\_length\_pck) + fine\_integration\_time)}{(vt\_pix\_clk\_freq\_mhz * 10^{6})}$$

It is required that:

coarse_integration_time < = (frame_length_lines - coarse_integration_time_max_margin)

If this limit is exceeded, the frame time will automatically be extended to (coarse_integration_time + coarse_integartion_time_max_margin) to accommodate the larger integration time.

Fine Integration Time Limits

The limits for the fine_integration_time can be found from fine_integration_time_min and fine_integration_time_max_margin. It is necessary to change fine_correction (R0x3010) when binning is enabled or the pixel clock divider (row_speed[2:0]) is used.

The corresponding fine_correction values are shown in following Table .

Fine_Integration_Time Limits

Register	No Row Binning			Row Binning		
row_speed[2:0]	1	2	4	1	2	4
fine_integration_time_min	0x02B0	0x0158	0x0AC	0x05F2	0x02FA	0x017E
fine_integration_time_max_margin	0x0212	0x0109	0x0086	0x0376	0x01BA	0x00DC

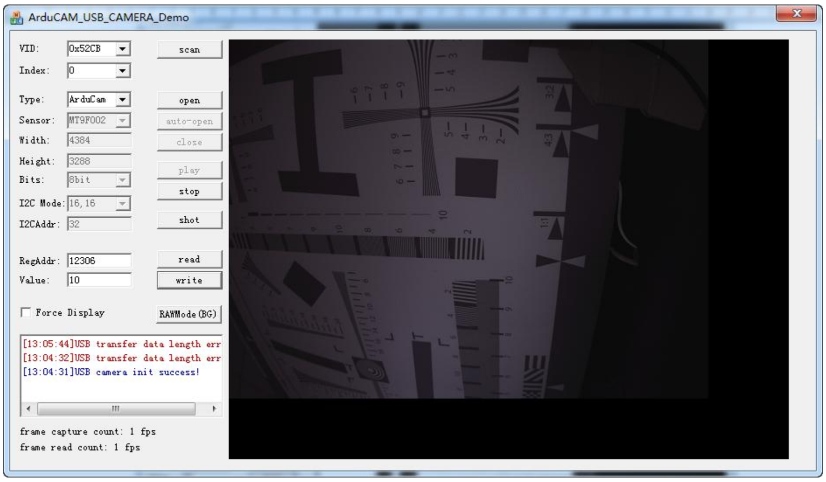
Fine Correction

For the fine_integration_time limits, the fine_correction constant will change with the pixel clock speed and binning mode.

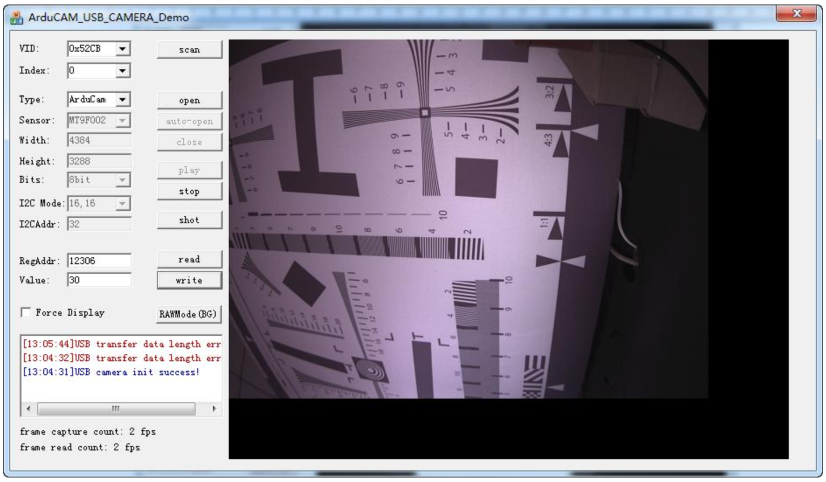
Fine_Correction Values

Register	No Row Binning			Row Binning		
row_speed[2:0]	1	2	4	1	2	4
fine_correction	0x094	0x044	0x01C	0x0183	0x0BB	0x057

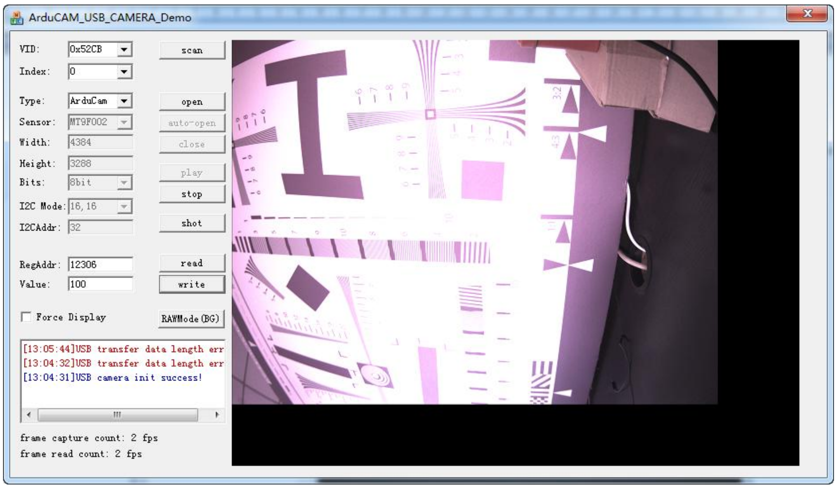
Given the pixel clock is 24MHz, line_length_pck_ register (0x300c) is 13248. In order to simplify the testing purpose, we only set the coarse_integration_time_ registe(0x3012).



Exposure = 5.5ms, RegAddr = 12306 (0x3012), Value = 10



Exposure = 16.5ms, RegAddr = 12306 (0x3012), Value = 30

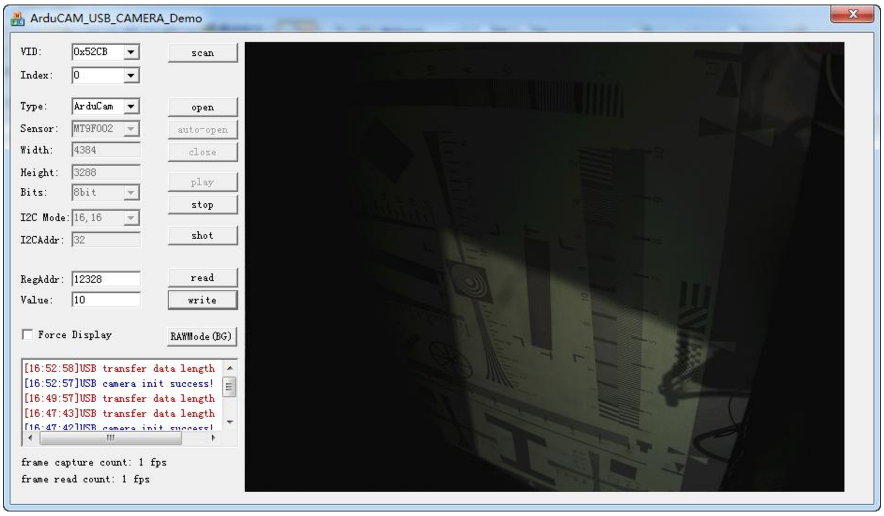


Exposure = 55ms, RegAddr = 12306 (0x3012), Value = 100

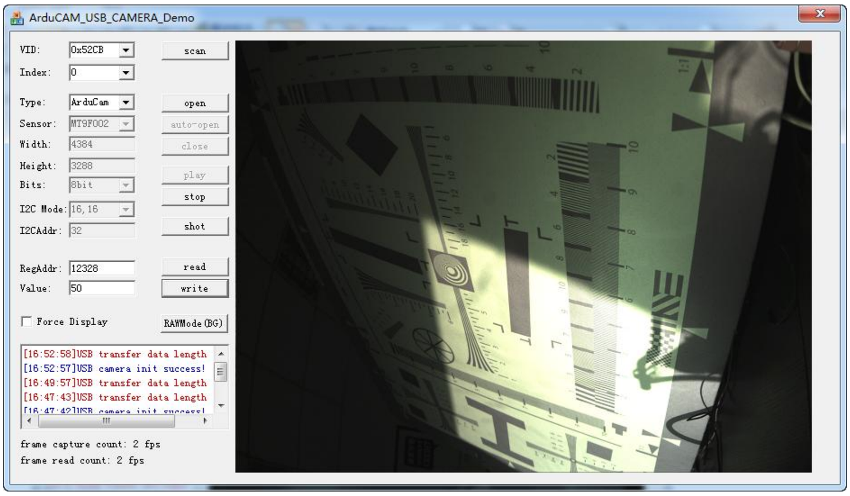
4.3 Adjust the Sensor Gain

Gain settings are like the ISO settings in most digital cameras. The gain is divided into analog and digital gain, and there are separate gain settings for four color-specific gains. There is also global gain setting to change all the four color-specific gains.

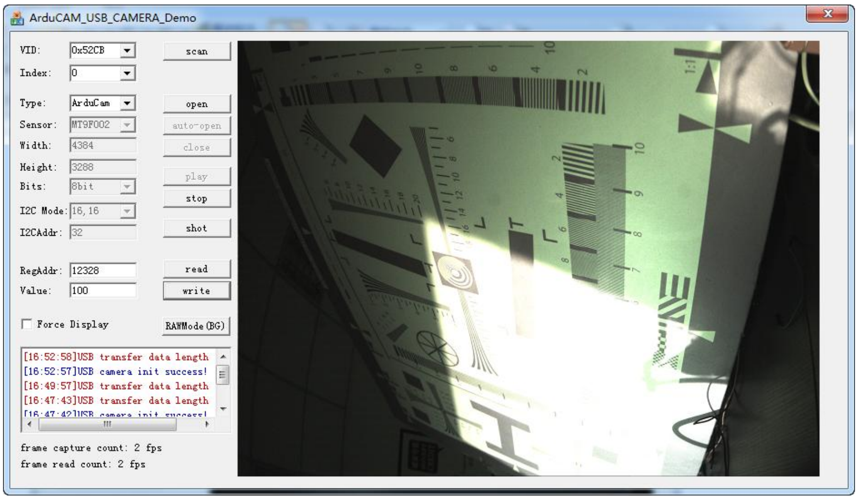
Here we demonstrate how to change the gain through the analogue_gain_code_global_ register (0x3028 in hex, 12328 in decimal). Given the exposure register 0x3012(12306) is 10.



RegAddr = 12328 (0x3028), Value = 10



RegAddr = 12328 (0x3028), Value = 50



RegAddr = 12328 (0x3028), Value = 100