OV518

Single Chip Camera to USB Bridge
OmniVision Technologies, Inc.
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Preliminary

Data Sheet Rev. 1.0

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1.1 General Features

- Low cost, single chip solution for USB PC camera applications
- 3.3V, 100-pin QFP
- No external DRAM required

1.2 Camera Interfaces

- OV6630 CMOS CIF color digital camera
- 4/8/16 bit camera input interface
- Built-in down-sampling, clamping and windowing circuits for CIF/SIF/QCIF/QSIF image resolutions

1.3 USB Features

- Built-in USB transceiver with selectable external USB transceiver interface
- 8 isochronous interface alternates of up to 7 Mbps USB transfer rate

1.4 Compression Engine

- Proprietary real-time compression engine
- CIF/SIF @ 30fps
- QCIF/QSIF @ 30fps

1.5 Misc.

- USB 1.1 compliance power management
- Programmable switching power clock with frequencies of 24/48/96/192 KHz
- Serial camera control bus
- General purpose I/O pins

2 Architecture

2.1 General Description

OV518, the Single Chip Camera to USB Bridge, is a single chip solution for USB PC camera applications. Along with OV6630 CMOS CIF color digital camera, OV518 comprises a low cost, highly integrated USB camera system. There is no additional DRAM or USB transceiver required.

OV518 takes YC_bC_r 422 CIF progressive video data from OV6630. The camera interface synchronizes with input video data and performs down-sampling, clamping and windowing functions with desired resolution that is requested by users through USB vendor commands.

OmniCE$^+$ is the enhanced proprietary compression engine that can achieve higher compression ratio.

Serial Camera Control Bus is implemented to get more flexibility to interface with cameras.

The functional blocks of OV518, as shown in figure 1, consist of Camera Interface, OmniCE$^+$, USB Interface, Serial Interface and System Controller.

2.2 Functional Description

2.2.1 Camera Interface

The Camera Interface supports 4/8/16 bit inputs. Depending on the width of selected video data input, the pixel clock generated by OV6630 varies from 6 (16-bit inputs) to 24MHz (4-bit inputs).

In order to achieve desired output image sizes, the Camera Interface supports down-sampling, clamping and windowing functions. The maximum output image size is 352 pixels by 288 lines (CIF), while the Camera Interface can be programmed to support its sub-images, such as SIF, QCIF & QSIF. It can also be programmed to support 420 outputs.

2.2.2 OmniCE$^+$

The OmniCE$^+$ is based on OmniCE compression engine and can achieve higher compression ratio. It can achieve 30fps at CIF format with better image quality.

2.2.3 USB Interface

The USB Interface is configured to support one configuration, one interface and eight alternates. Two endpoints are implemented in the USB Interface. Endpoint 0 is an IN-OUT type CONTROL endpoint that is the pipe of descriptors and vendor commands. Endpoint 1 is an IN type ISOCHRONOUS endpoint that is the pipe of video stream. The bandwidth of the video stream varies from 0 (alternate 0) to 7 Mbps (alternate 7).

Device descriptor, configuration descriptor, interface descriptor, endpoint descriptor and string descriptor are hardcoded in the USB interface.

2.2.4 Serial Camera Control Bus

A built-in Serial Camera Control Bus provides flexibility to interface with cameras.

2.2.5 System Controller

The System Controller provides clock and reset signals to the whole chip, as well as some control functions such as GPIO (General Purpose I/O). The GPIO function provides users the flexibility to extend external control logics. Each bit of the GPIO can be programmed as either input mode or output mode. When it is programmed as the input mode, two sub-modes are supported and programmable; the positive/negative edge triggered input mode and the level triggered input mode.
GPIO0 also performs as SCSB for Serial Camera Control Bus.

Figure 1. Functional Block Diagram

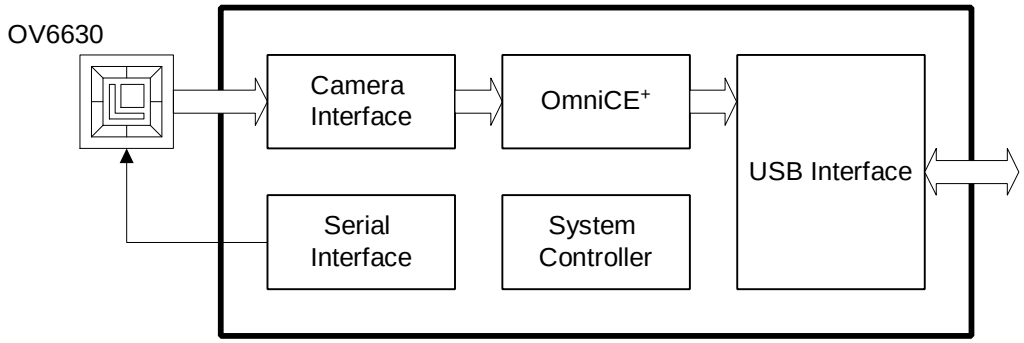
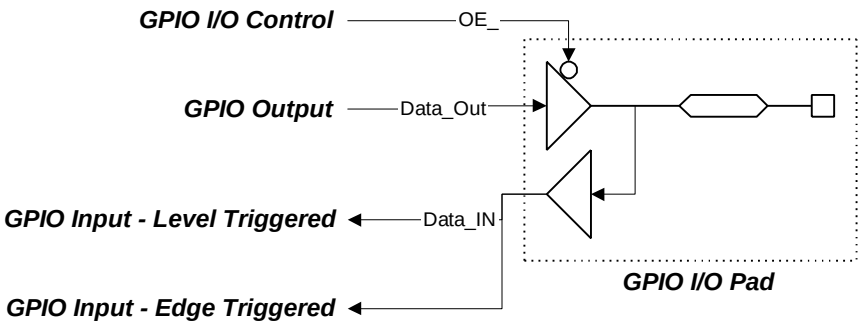


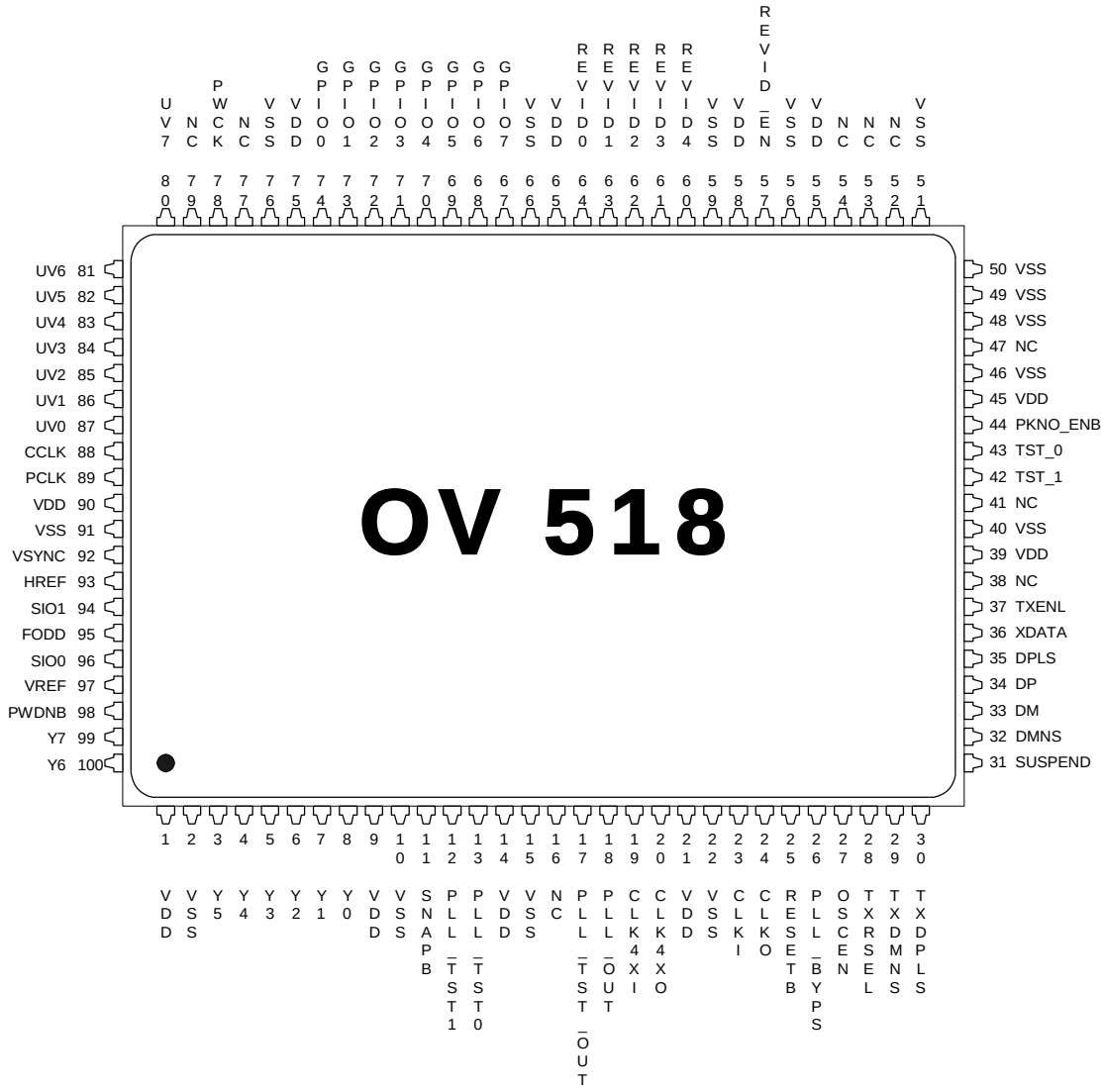
Figure 2. GPIO Structure



3 Pin Definition

3.1 Pin Assignments

Figure 3. 100-Pin QFP Package



3.2 Pin Descriptions

Table 1. Pin Descriptions – Camera Interface (24 pins)

Pin #	Name	I/O	Function
99, 100, 3~8	Y[7:0]	I	Camera Y input
78	PWCK	O	Camera switching power clock. Software programmable
80~87	UV[7:0]	I	Camera C_bC_r input
88	CCLK	O	Camera clock output. Software programmable
89	PCLK	I	Camera pixel clock input
92	VSYNC	I	Camera vertical sync input
93	HREF	I	Camera horizontal window reference input
95	FODD	I	Camera even/odd field input
97	VREF	I	Camera vertical window reference input
98	PWDNB	O	Camera power-down control output

Table 2. Pin Descriptions – Serial Camera Control Bus (2 pins)

Pin #	Name	I/O	Function
94	SIO1	O	Serial camera control signal 1 output
96	SIO0	I/O	Serial camera control signal 0 input/output

Table 3. Pin Descriptions – USB Interface (10 pins)

Pin #	Name	I/O	Function
28	TXRSEL	I	Internal/external transceiver select. 0 for internal
29	TXDMNS	O	NRZI formatted D- output (external transceiver)
30	TXDPLS	O	NRZI formatted D+ output (external transceiver)
31	SUSPEND	O	Suspend (external transceiver)
32	DMNS	I	D- input (external transceiver)
33	DM	I/O	D- input/output (internal transceiver)
34	DP	I/O	D+ input/output (internal transceiver)
35	DPLS	I	D+ input (external transceiver)
36	XDATA	I	USB differential receiver data input (external transceiver)
37	TXENL	O	Output enable for differential driver (external transceiver)

Table 4. Pin Descriptions – Clock & Reset (11 pins)

Pin #	Name	I/O	Function
12~13	PLL_TST[1:0]	I	PLL test mode
17	PLL_TST_OUT	O	PLL test output
18	PLL_OUT	I	PLL output select. 1 for connecting PLL output to CLK4XO
19	CLK4XI	I	Feedback input of CLK4XO
20	CLK4XO	O	PLL output
23	CLK_I	I	48MHz/12MHz (when PLL is enabled) oscillator/crystal input.
24	CLK_O	O	48MHz/12MHz (when PLL is enabled) crystal output
25	RESETB	I	Power-On Reset input. Low-active
26	PLL_BYPS	I	PLL by-pass select. 0 for PLL enabled
27	OSC_EN	O	Power control for oscillator. 1 for power enabled

Table 5. Pin Descriptions – Revision ID (6 pins)

Pin #	Name	I/O	Function
57	REVID_EN	I	Revision ID enabled input. 1 for enabled
60~64	REVID[4:0]	I	Revision ID inputs

Table 6. Pin Descriptions – GPIO (8 pins)

Pin #	Name	I/O	Function
67~74	GPIO[7:0]	I/O	General purpose I/O

Table 7. Pin Descriptions – Misc. (4 pins)

Pin #	Name	I/O	Function
11	SNAPB	I	Snapshot button input
42~43	TST[1:0]	I	Test inputs
44	PKNO_ENB	I	Packet number enabled input. 0 for enabled

Table 8. Pin Descriptions – NC (9 pins)

Pin #	Name	I/O	Function
16, 38, 41, 47, 52, 53, 54, 77, 79	NC		No connection

Table 9. Pin Descriptions – Power & Ground (26 pins)

Pin #	Name	I/O	Function
1, 9, 14, 21, 39, 45, 55, 58, 65, 75, 90	VDD		Power
2, 10, 15, 22, 40, 46, 48, 49, 50, 51, 56, 59, 66, 76, 91	VSS		Ground

4 Electrical Characteristics

Table 10. DC Electrical Characteristics
V_{DD} = 3.0V~3.6V, TA = 0 to 70°C

Symbol	Parameter	Condition	Min	Max	Unit
V_{IH}	High level input voltage	CMOS	0.7xV_{DD}	V_{DD}+0.5	V
V_{IH}	High level input voltage	TTL	2.0	V_{DD}+0.5	V
V_{IL}	Low level input voltage	CMOS	-0.5	0.3xV_{DD}	V
V_{IL}	Low level input voltage	TTL	-0.5	0.8	V
V_{OH}	High level output voltage	CMOS	V_{DD}-0.1		V
V_{OH}	High level output voltage	TTL	2.4		V
V_{OL}	Low level output voltage	CMOS		V_{SS}+0.1	V
V_{OL}	Low level output voltage	TTL		0.4	V

Table 11. Recommended Operating Conditions

Symbol	Parameter	Rating	Unit
V_{DD}	DC supply voltage 3.3V	3.0 to 3.6	V
T_A	Commercial temperature	0 to 70	°C

Table 12. USB DC Electrical Characteristics

Symbol	Parameter	Condition	Min	Max	Unit
V_{IH}	Input level high (driven)	R_L 1.5kΩ to GND	2.0		V
V_{IL}	Input level low	R_L 1.5kΩ to 3.6V		0.8	V
V_{DI}	Differential input sensitivity	| (D+) – (D-) |	0.2		V
V_{CM}	Differential common mode range		0.8	2.5	V
V_{OL}	Static output low	R_L 1.5kΩ to 3.6V	0.0	0.3	V
V_{OH}	Static output high	R_L 1.5kΩ to GND	2.8	3.6	V
I_{CCS}	Suspended device			2	uA

Table 13. USB Full Speed Output Driver Electrical Characteristics

Symbol	Parameter	Condition	Min	Max	Unit
T_R	Rise time	CL=50pF	4	20	ns
T_f	Fall time	CL=50pF	4	20	ns
T_{rim}	Rise / Fall time matching	(Tr/Tf)	90	110	%
Z_{drv}	Driver output resistance	Steady state drive	28	44	Ω

5 Register Table (Vendor Commands)

5.1 System Control

Table 14. System Control Register List

Register Address	Register Name	R/W	Function	Default Value
54h	DEBCK[3:2] PWCK[1:0]	RW	Bit 3~2: GPIO de-bounced clock select 00: 375Hz 01: 750Hz 10: 1.5KHz 11: 96KHz Bit 1~0: Switching power clock output select 00: 24KHz 01: 48KHz 10: 96KHz 11: 192KHz	0Eh
55h	GDI[7:0]	R	Bit 7~0: GPIO data inputs	~
56h	GDO[7:0]	RW	Bit 7~0: GPIO data outputs	00h
57h	GIOCT[7:0]	RW	Bit 7~0: GPIO IO control 0: output mode 1: input mode	FFh
58h	GPDI[7:0]	R	Bit 7~0: GPIO pulse data inputs	~
59h	GPCR[7:0]	W	Bit 7~0: GPIO pulse clear 0: normal 1: clear	~
5Ah	GPP[7:0]	RW	Bit 7~0: GPIO pulse polarity 0: positive pulse 1: negative pulse	FFh
5Bh	GPEN[7:0]	RW	Bit 7~0: GPIO pulse enabled 0: disabled 1: enabled	00h
5Ch	GRM[7:0]	RW	Bit 7~0: GPIO reset mask 0: normal 1: mask	FFh
5Eh	USR[7:0]	RW	Bit 7~0: User defined read/write register bits	00h
5Fh	REVID[4:0]	R	Bit 4~0: Revision ID which links to input pins “REVID[4:0]”	~

6 USB Descriptors

The USB descriptor is a data structure with defined attributes that can respond requests from the USB host. Descriptors of OV518 are hardcoded.

6.1 Device

The device descriptor describes general information about OV518. There is one device descriptor.

Table 15. Device Descriptor List

Offset	Field	Size	Value (Hex)	Description
0	blength	1	12	Size of descriptor in bytes
1	bdescriptorType	1	01	DEVICE Descriptor Type
2	bcdUSB	2	0110	USB Spec Release No.
4	bdeviceClass	1	00	Class code
5	bdeviceSubClass	1	00	Subclass code
6	bdeviceProtocol	1	00	Protocol code
7	bmaxPacketSize0	1	08	Max. packet size for enpt0
8	idVendor	2	05a9	Vendor ID
10	idProduct	2	0518	Product ID
12	bcdDevice	2	0100	Device release No.
14	imanufacturer	1	01	Index of string descriptor describing manufacturer
15	iproduct	1	02	Index of string descriptor describing product
16	iserialNumber	1	00	Index of string descriptor describing the device's serial no.
17	bnumConfigurations	1	01	Number of possible configurations

6.2 Configuration

The configuration descriptor describes information about a specific device configuration. There is one configuration descriptor.

Table 16. Configuration Descriptor List

Offset	Field	Size	Value (Hex)	Description
0	blength	1	09	Size of descriptor in bytes
1	bdescriptorType	1	02	CONFIGURATION
2	wtotalLength	2	0089	Total length of data returned for this configuration
4	bnumInterfaces	1	01	No. of interfaces supported by this config.
5	bconfigurationValue	1	01	Value to use to Set Config. to select this config.
6	iconfiguration	1	00	Index of string descriptor describing this config.
7	bmAttributes	1	80	Config. char. bus powered, no remote wakeup
8	MaxPower	1	FA	Max. power consumption, 500 mA

6.3 Interface & Endpoint

The interface descriptor describes a specific interface provided by the associated configuration. There are eight interface descriptors. Each one selects one alternate setting and is followed by the corresponding endpoint descriptor.
The endpoint descriptor describes the information required by the host to determine the bandwidth requirements of each endpoint. There is no endpoint descriptor for endpoint zero.

Table 17. Interface Descriptor List of Alternate 0~7

Offset	Field	Size	Value (Hex)	Description
0	blength	1	09	Size of descriptor in bytes
1	bdescriptorType	1	04	INTERFACE
2	binterfaceNumber	1	00	No. of interface
3	balternateSetting	1	00~07	Value used to select alternate setting
4	bnumEndpoints	1	01	No. of endpoints used by this interface
5	binterfaceClass	1	FF	Class code
6	binterfaceSubClass	1	00	SubClass code
7	binterfaceProtocol	1	00	Protocol code
8	iInterface	1	00	Index of string descriptor describing this interface

Table 18. Endpoint Descriptor List of Alternate 0~7

Offset	Field	Size	Value (Hex)	Description
0	blength	1	07	Size of descriptor in bytes
1	bdescriptorType	1	05	ENDPOINT
2	bendpointAddress	1	81	Bit7 1 In Enpt, Bit 6..4 000, Bit 3..0 0001 Enpt No.
3	bmAttributes	1	01	Bit1..0 01 Iso
4	wmaxPacketSize	2	0000 0080/0081 0100/0101 0180/0181 0200/0201 0280/0281 0300/0301 0380/0381	Max. packet size 0~7
6	binterval	1	01	Interval for polling enpt for data transfer

6.4 String

String descriptors are hardcoded and two stings are supported.

Table 19. String Descriptor List 0

Offset	Field	Size	Value (Hex)	Description
0	blength	1	04	Size of descriptor in bytes
1	bDescriptorType	1	03	STRING descriptor type
2	wLANGID[0]	2	0409	LANGID code zero

Table 20. String Descriptor List 1 (iManufacturer)

Offset	Field	Size	Value (Hex)	Description
0	blength	1	3C	Size of descriptor in bytes
1	bDescriptorType	1	03	STRING descriptor type
2	bString	58	004F 006D 006E 0069 0056 0069 0073 0069 006F 006E 0020 0054 0065 0063 0068 006E 006F 006C 006F 0067 0069 0065 0073 002C 0020 0049 006E 0063 002E	UNICODE encoded string (OmniVision Technologies, Inc.)

Table 21. String Descriptor List 2 (iProduct)

Offset	Field	Size	Value (Hex)	Description
0	blength	1	16	Size of descriptor in bytes
1	bDescriptorType	1	03	STRING descriptor type
2	bString	20	0055 0053 0042 0020 0043 0061 006D 0065 0072 0061	UNICODE encoded string (USB Camera)

7 Mechanical Information

Dimensions in Millimeters