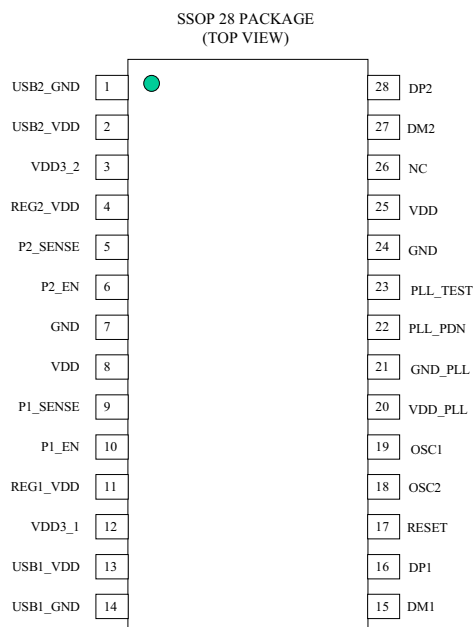# PL-2301 - USB Bridge Device

Features

- □ Transfer files between two PCs
- □ Full compliance with the Universal Serial Bus Specification Version 1.1
- □ USB full speed connection
- □ Dual data buffer supporting two-way data transfer
- □ Low power consumption
- □ Support suspend and resume for power management
- □ Support remote wake-up
- □ PnP driver running on Win98 and Win95 OSR 2.1
- □ Bus powered from either USB port
- □ Suitable for mobile PC environment
- □ On chip USB transceiver
- □ On chip oscillator using one 12M Hz crystal
- □ No glue logic needed; can be embedded in small space
- □ 28 Pins SSOP package

SSOP 28 PACKAGE
(TOP VIEW)

| Left Pin	#		#	Right Pin
USB2_GND	1		28	DP2
USB2_VDD	2		27	DM2
VDD3_2	3		26	NC
REG2_VDD	4		25	VDD
P2_SENSE	5		24	GND
P2_EN	6		23	PLL_TEST
GND	7		22	PLL_PDN
VDD	8		21	GND_PLL
P1_SENSE	9		20	VDD_PLL
P1_EN	10		19	OSC1
REG1_VDD	11		18	OSC2
VDD3_1	12		17	RESET
USB1_VDD	13		16	DP1
USB1_GND	14		15	DM1

1. Introduction

The PL-2301 operates as a bridge between two PCs, like the serial, parallel cables, and IrDA, which are widely utilized in PC-to-PC communication nowadays. With a more advanced bus protocol and operation system, this USB bridge cable could offer much higher bandwidth and easier user interface.

This chip is embedded into a link cable. Either port is a upstream port which could join a USB network, i.e. a PC's USB connector or a USB hub's downstream port. By means of switching and protocol changing in the chip, any two PCs or USB hosts can communicate with each other. The bulk-type data format are adopted for maximum speed. In addition, data are allowed to flow in both directions simultaneously without any performance compromising. The PCs can control the device using standard USB command, while the data flow is directed by a vendor-specific scheme.

As shown in the block diagram, this ASIC contains two USB units working independently. Together with the two FIFOs and control logics in between, they exchange data with no blocking. All the clock oscillator, PLL, voltage regulators, USB transceivers, and power-on reset circuits are integrated on chip. There is no glue logics needed. This chip is designed for handy cable utility.
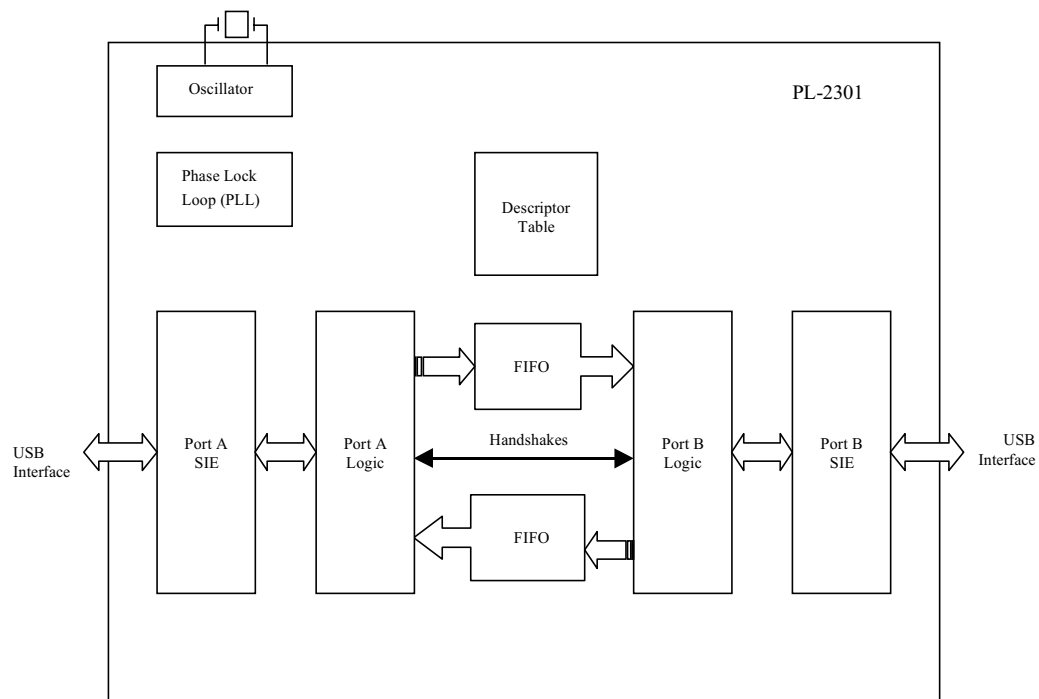
PL-2301 Block Diagram

Company Confidential

2. Signal Definition

The following table describes each pin:

I – Input signal

O – Output signal

I/O – Bi-directional signal

P – Power/Ground

N – No connect

Pin	Name	Type	Description
1	USB2_GND	P	Port 2 USB ground
2	USB2_VDD	P	Port 2 USB VDD
3	VDD3_2	P	Port 2 Transceiver Power
4	REG2_VDD	P	Regulator Power
5	P2_SENSE	I	Port 2 sense
6	P2_EN	O	Port 2 power enable
7	GND	P	Ground
8	VDD	P	Power
9	P1_SENSE	I	port 1 sense
10	P1_EN	O	Port 1 power enable
11	REG1_VDD	P	Regulator Power
12	VDD3_1	P	Port 2 Transceiver Power
13	USB1_VDD	P	Port 1 USB VDD
14	USB1_GND	P	Port 1 USB ground
15	DM1	I/O	Port 1 USB DMINUS signal
16	DP1	I/O	Port 1 USB DPLUS signal
17	RESET	I	System Reset
18	OSC2	O	Crystal oscillator output
19	OSC1	I	Crystal oscillator input
20	VDD_PLL	P	PLL Power
21	GND_PLL	P	PLL Ground
22	PLL_PDN	I	PLL trigger
23	PLL_TEST	I	PLL test mode control
24	GND	P	Ground
25	VDD	P	VDD
26	NC	N	No connect
27	DM2	I/O	Port 2 USB DMINUS signal
28	DP2	I/O	Port 2 USB DPLUS signal

3. PL-2301 Descriptors

● Device
● Configuration
● Interface
● Endpoint.
   - Control endpoint. The default endpoint 0 is used to retrieve the state and Control.
   - Interrupt endpoint. Accessed as endpoint 1, each interrupt data is one bytes.
   - Bulk Out endpoint. Accessed as endpoint 2, the maximum data length per Packet is 64 bytes, which meets the upper limit of USB protocol.
   - Bulk In endpoint. Accessed as endpoint 3, the maximum data length per packet is also 64 bytes.
● Status.
   - Device status
   - Interface status
   - Endpoint 0 status
   - Endpoint 1 status
   - Endpoint 2 status
   - Endpoint 3 status

3.1 String.

The PL-2301 supports the Manufacturer strings:

Offset	Content	Note
0	04h	String Index 0
1	03h	
2:3	0409h	Language ID for English (United States).
4	32h	String Index 1
5	03h	
6:53	00h, 'P'; 00h, 'r'; 00h, 'o'; 00h, 'l'; 00h, 'i'; 00h, 'f'; 00h, 'i'; 00h, 'c' ; 00h, ' ' ; 00h, 'T'; 00h, 'e'; 00h, 'c'; 00h, 'h'; 00h, 'n'; 00h, 'o'; 00h, 'l' ; 00h, ' o ' ; 00h, 'g'; 00h, 'y'; 00h, ' '; 00h, 'I'; 00h, 'n'; 00h, 'c'; 00h, '.';	"Prolific Technology Inc." 00h is padded for UNICODE.

The String index 0, by USB Specification, is defined as Language ID. The PL-2301 supports only manufacturer ID accessed by String index 1.

3.2 Device Descriptor

A device descriptor contains the global definitions of a device. There is only one device description for the device.

Device Descriptor

Offset	Field	Size	Value	Description
0	Blength	Byte	12h	Size of this descriptor, in bytes.
1	BdescriptorType	Byte	01h	DEVICE descriptor type.
2	BcdUSB	Word	0100h	USB Specification Release Number.
4	BdeviceClass	Byte	00h	
5	BdeviceSubClass	Byte	00h	
6	BdeviceProtocol	Byte	00h	
7	BmaxPacketSize0	Byte	08h	Maximum packet size for endpoint 0.
8	IdVender	Word	067Bh	Vender ID.
10	IdProduct	Word	0000h	Product ID.
12	BcdDevice	Word	0000h	Release number (BCD) 0.0.
14	iManufacturer	Byte	01h	Index of string descriptor describing manufacturer.
15	iProduct	Byte	00h	Index of string descriptor describing this product.
16	iSerialNumber	Byte	00h	Index of string descriptor describing the device serial number.
17	bNumConfigurations	Byte	01h	One possible configurations.

3.3 Configuration Descriptor

The default configuration descriptor is used, which contains only one interface. When accessed, all the configuration descriptor, the interface descriptor, and all the endpoint descriptors are returned.

Configuration Descriptor

Offset	Field	Size	Value	Description
0	bLength	Byte	09h	Size of this descriptor, in bytes.
1	bDescriptorType	Byte	02h	CONFIGURATION descriptor type.
2	wTotalLength	Word	0027h	Total length of data returned for this configuration.
4	bNumInterface	Byte	01h	One interface for this device.
5	bConfigurationValue	Byte	01h	
6	iConfiguration	Byte	00h	
7	bmAttributes	Byte	A0h	Bus powered, remote wakeup.
8	MaxPower	Byte	32h	Maximum power consumption is 100 mA.

3.4 Interface Descriptor

The interface descriptor contains all relevant definition fully describing the device. There is only one setting for the interface.

Interface Descriptor

Offset	Field	Size	Value	Description
0	bLength	Byte	09h	Size of this descriptor, in bytes.
1	bDescriptorType	Byte	04h	INTERFACE descriptor type.
2	bInterfaceNumber	Byte	00h	
3	bAlternateSetting	Byte	00h	
4	bNumEndpoints	Byte	03h	
5	bInterfaceClass	Byte	FFh	Vender-Specific class
6	bInterfaceSubClass	Byte	00h	
7	bInterfaceProtocol	Byte	00h	
8	iInterface	Byte	00h	

3.5 Endpoint Descriptors

3.5.1 Control Endpoint Descriptor

Since endpoint 0 is used as the default control endpoint, there is no dedicated standard or class-specific control endpoint descriptor.

3.5.2 Interrupt Endpoint Descriptor

Endpoint 1 Descriptor

Offset	Field	Size	Value	Description
0	bLength	Byte	07h	Size of this descriptor, in bytes.
1	bDescriptorType	Byte	05h	ENDPOINT descriptor type.
2	bEndpointAddress	Byte	81h	
3	bmAttributes	Byte	03h	Transfer type is INTERRUPT.
4	wMaxPacketSize	Word	0001h	1 Byte
6	bInterval	Byte	01h	Polling on every 1 ms interval.

3.5.3 Bulk-Out Endpoint Descriptor

Endpoint 2 descriptor

Offset	Field	Size	Value	Description
0	bLength	Byte	07h	Size of this descriptor, in bytes.
1	bDescriptorType	Byte	05h	ENDPOINT descriptor type.
2	bEndpointAddress	Byte	02h	
3	bmAttributes	Byte	02h	Transfer type is BULK.

4	wMaxPacketSize	Word	0040h	64 bytes.
6	bInterval	Byte	00h	Ingnored.

3.5.4 Bulk-In Endpoint Descriptor

Endpoint 3 Descriptor

Offset	Field	Size	Value	Description
0	bLength	Byte	07h	Size of this descriptor, in bytes.
1	bDescriptorType	Byte	05h	ENDPOINT descriptor type.
2	bEndpointAddress	Byte	83h	
3	bmAttributes	Byte	02h	Transfer type is BULK.
4	wMaxPacketSize	Word	0040h	64 bytes.
6	bInterval	Byte	00h	Ingnored.

4. Device Requests

The PL-2301 can respond to two types of requests:
- Standard USB device request.
- Vendor-specific requests.

4.1 Standard Requests

The PL-2301 can respond to the following standard requests:
- Clear Feature.
- Get Configuration
- Get Descriptor
- Get Interface
- Get Status
- Set Address
- Set Configuration
- Set Feature
- Sync Frame

4.2 Vender-Specific Requests

Vendor-Specific Request

Label	bmRequestType	bRequest	wValue	wIndex	wLength	Data
ClearQuickLinkFeature	01000001b	1	7:0	0	0	None
SetQuickLinkFeature	01000001b	3	7:0	0	0	None
ClearHardwareFeature	01000001b	1	3:0	1	0	None
SetHardwareFeature	01000001b	3	3:0	1	0	None

The ClearQuickLinkFeature and SetQuickLinkFeature are used to control the handshakes during data transfer; the ClearHardwafeFeature and SetHardwareFeature are used to control some special-purposed hardware feature. They are 8-bit configuration for the QuickLinkFeature and 4-bit configuration for the HardwareFeature. Each bit should be set by the Set_xxx command and Cleared by Clear_xxx command.

4.2.1 QuickLinkFeature

QuickLinkFeature Configuration

Name	Bit	Definition	Default
S_EN	7	Suspend Enable: 1: Suspend enable 0: Suspend disable	0
RESERVED	6:5	Reserved	00
RESET_O	4	Reset Output Pipe: Reset the bulk-out transfer, and notify the USB peer as RESET_IN 1: Reset output pipe 0: normal function	0
RESET_IN	3	Reset Input Pipe: Reset the bulk-in transfer, and notify the USB peer as RESET_O 1: Reset input pipe 0: Normal function	0
TX_C	2	Transfer Complete: Telling the USB peer the transfer being complete, no more data will be sent 1: Transfer complete 0: Transfer Not complete or no transfer at all	0
TX_REQ	1	Transfer Request: Telling the USB peer a transfer request being issued 1: Transfer request 0: No transfer request	0
PEER_E	0	Peer Exist: Telling the USB peer its existence and normal function 1: Peer exist 0: Peer not exist	0

S_EN is the Suspend-enable bit. At initial state, the PL-2301 does not support the Suspend function. When Set, it will support the standard USB Suspend scheme. By

default, the client driver will set the S_EN bit. To be reminded, this device also supports the standard remote wake-up protocol defined in USB Spec. 1.0
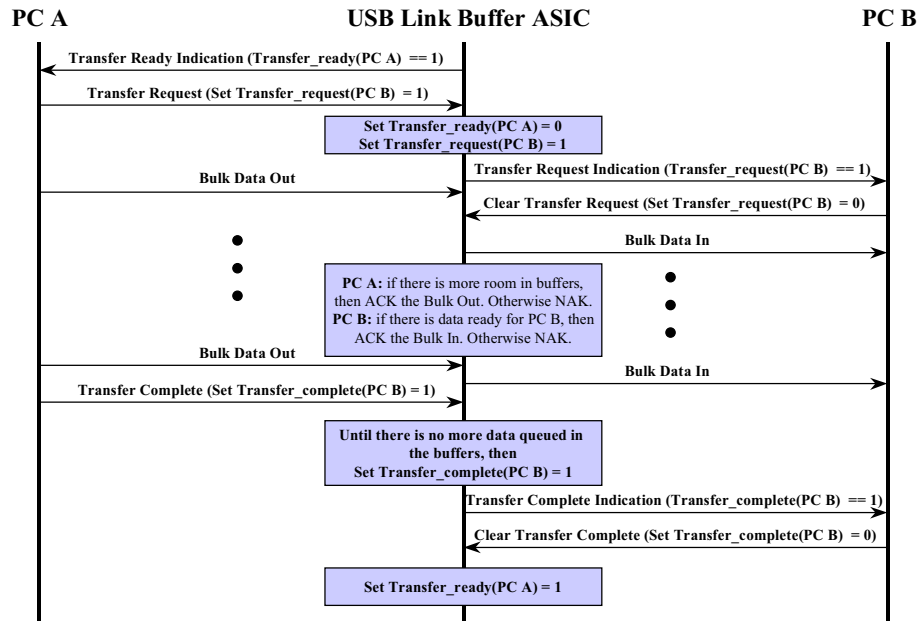
The reset bits, bit 0 through bit 4, are handshakes between the two USB hosts. The set-clear scheme are from opposite ports, except PEER_E bit. That means, bit 1 through bit 4 have to be set from one port and be cleared from the other port. While bit 0 is set and clear from the same port.

After detecting a PL-2301connecting, the PC will boot the USB client driver up, and set the PEER_E bit to inform the PC on the other side that th peer exists. Usually, the software will not reset the PEER_E bit. While one USB port is unplugged from one PC, the associated PEER_E bit will be reset. This tells its PC counterpart, the peer non-existing.

The TX_REQ and TX_C handshakes are used to initiate and finish data transfer. At first, PC A set TX_REQ to inform PC B a transfer request. PC B then acknowledges by clearing TX_REQ. After PC A finish the data transfer, it sets the TX_C. Again, PC B acknowledges by clearing TX_C.

The RESET_IN and RESET_O are used to reset the data pipes in error conditions. When RESET_IN is asserted by one PC, it reset all the FIFO and state machines on the input pipe. The status is also passed to the PC counterpart as RESET_O, which status should be cleared from there to finish the whole operation. Likewise, when one PC asserts RESET_O, it reset all the FIFO and state machines on the output pipe, and informs its PC counterpart as RESET_IN, which then should be cleared from there.

The following diagram describes the data transfer scenario. Transfer Ready is a hardware signal reflecting the busy status of the data path, which is also reflected as bit[5] of interrupt data.

PC A   USB Link Buffer ASIC   PC B

Transfer Ready Indication (Transfer_ready(PC A) == 1)

Transfer Request (Set Transfer_request(PC B) = 1)

Set Transfer_ready(PC A) = 0
Set Transfer_request(PC B) = 1

Transfer Request Indication (Transfer_request(PC B) == 1)

Bulk Data Out

Clear Transfer Request (Set Transfer_request(PC B) = 0)

Bulk Data In

PC A: if there is more room in buffers, then ACK the Bulk Out. Otherwise NAK.
PC B: if there is data ready for PC B, then ACK the Bulk In. Otherwise NAK.

Bulk Data Out

Bulk Data In

Transfer Complete (Set Transfer_complete(PC B) = 1)

Until there is no more data queued in the buffers, then
Set Transfer_complete(PC B) = 1

Transfer Complete Indication (Transfer_complete(PC B) == 1)

Clear Transfer Complete (Set Transfer_complete(PC B) = 0)

Set Transfer_ready(PC A) = 1

4.2.2 HardwareFeature

The HardwareFeature configuration are reserved for test items during development phase. They are not supposed to mean anything after then.

HardwareFeature Configuration

Name	Bit	Definition	Default
SHUT_EN	3	Clock Shut-down Enable: 1: The oscillator works even in Suspend 0: Shutdown the oscillator in Suspend to save power	0
C_SHORT	2	Counter Short: 1: PLL is inhibited for 32 cycles after the oscillator starts to oscillate . 0: PLL waits for 64k cycle before working	0
Reserved	1	Reserved	0
S_SHORT	0	Suspend Short: 1: Suspend counter counts upto 512 cycles (without getting SOF), the device will Suspend itself. 0: Suspend counter counts to 32k cycles to get into Suspend	0

5. INTERRUPT ENDPOINT OPERATIONS

The handshakes passing and status report are by way of interrupt pipe. Each interrupt

data payload consists of 1 byte. The data format is as following:

Interrupt Byte:

Name	Bit	Description	Default
RESERVED	7:6	RESERVED	00
TX_RDY	5	Transfer Ready: Showing the readiness of the local USB port for data transfer 1: Transfer ready 0: Transfer busy	0
RESET_O	4	Reset Output Pipe: Combining RESET_IN bit of the USB counterpart's QuicklinkFeature Configuration and the local USB's RESET_O 1: Reset output pipe 0: normal function	0
RESET_IN	3	Reset Input Pipe: Combining RESET_O bit of the USB counterpart's QuicklinkFeature Configuration and the local USB's RESET_IN 1: Reset input pipe 0: Normal function	0
TX_C	2	Transfer Complete: Reflect TX_C bit of the USB counterpart's QuicklinkFeature Configuration 1: Transfer complete 0: Transfer Not complete or no transfer at all	0
TX_REQ	1	Transfer Request: Reflect TX_REQ bit of the USB counterpart's QuicklinkFeature Configuration 1: Transfer request 0: No transfer request	0
PEER_E	0	Peer Exist: Reflect PEER_E bit of the USB counterpart's QuicklinkFeature Configuration 1: Peer exist 0: Peer not exist	0

6. Electrical Characteristics

6.1 Absolute Maximum Ratings

Power Supply Voltage   --------   -0.3 to 6.0 V

Input Voltage   ----------   GND-0.3 to V_{DD}+0.3 V

Storage Temperature   --------   -40 to 125 ℃

6.2 DC Characteristics

Parameter	Symbol	Min	Typ	Max	Units
Power Supply Current	I_{DD}	0.5	19	24	mA
Input Voltage Low High	V_{IL} V_{IH}	-- 0.7* V_{DD}	-- --	0.3* V_{DD} --	V V
Output Voltage Low High	V_{OL} V_{OH}	-- 3.5	-- --	0.4 --	V V
Input leakage current	I_L	-1	--	1	uA
Tri-state leakage current	Ioz	-10	--	10	uA
Input Capacitance	C_{IN}	--	3	--	pf
Output Capacitance	C_{OUT}	--	3	--	pf
Bi-directional buffer Capacitance	C_{BID}	--	3	--	pf
Junction Operation Temperature	T_J	0	25	115	℃
Operating Voltage Range	--	4.1	5	5.25	V
Operating Temperature	--	-40	--	85	℃

6.3 USB Transceiver Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
Rise and Fall Times: (10%—90%) (90%—10%)	T_R T_F	4 4	8 8	15 15	ns ns
Cross Point	Vcr	1.3	--	2.0	V
Output Impedance	R_D	23	28	33	ohm
High Level Output	V_{OH}	2.8	--	--	V
Low Level Output	V_{OL}	--	--	0.7	V
High Level Iutput	V_{OH}	2.0	--	--	V
Low Level Iutput	V_{OL}	--	--	0.8	V

● CL :50pf

6.4 Clock Characteristics

Parameter	Min	Typ	Max	Unit
Frequency of Operation	11.976	12.000	12.024	MHz
Clock Period	83.1	83.3	83.5	ns
Duty Cycle	45	50	55	%

7. PACKAGE DIMENSIONS   (28-PIN   SSOP)

SYMBOL	MILLIMETERS			INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
b	0.22		0.38	0.009		0.015
E	7.40	7.80	8.20	0.291	0.307	0.323
E1	5.00	5.30	5.60	0.197	0.209	0.220
L	0.55	0.75	0.95	0.021	0.030	0.037
R1	0.09			0.004		
D	9.9	10.2	10.5	0.390	0.402	0.413
A			2.0			0.079
e		0.65			0.0256	
L1		1.25			0.050	
A1	0.05			0.020		
A2	1.65	1.75	1.85	0.065	0.069	0.073

DETAIL A

DETAIL A