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Ease the Burden of USB Connectivity with CP21xx USB Bridges

Agenda

USB bridging

- USB to UART Virtual Com Port (VCP) devices
- USB to UART Human Interface Device class (HID) devices

Features and benefits

Silicon Labs USB interface devices

- USB to UART
- USB to SMBus\l2C
- USB Interface device development flow
- Customization and certification
- Summary
- Development tools





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USB Bridging

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USB Interface Devices

Used as a bridge between communications interfaces

Examples: USB to UART, USB to SMBus\l2C

Can upgrade legacy devices and speed time to market

- No USB expertise required
- No low level driver development required
- Easiest way to add USB to an existing system with minimal system redesign





USB Virtual Com Port (VCP) Bridges

Fixed function USB to UART bridges provide the easiest method for upgrading legacy RS-232 systems with USB

Requires no firmware or driver development

- Host application software remains unchanged since it still accesses a standard com port
- Uses custom virtual com port driver (provided by Silicon Labs) to pass data from the com port to the USB low level stack

Requires a driver installation step

 Silicon Labs VCP - HyperTerminal File Edit View Call Transfer Help ご	Looks like a Standard Com Po	ort
Connect To Silicon Labs VCP Enter details for the phone number that you want to Country/region: United States (1) Area code: 512 Phone number: Connect using: COM4 OK Cance	diat diat Vot Settings Bits per second: Data bits: Parity: Stop bits: Flow controt: 1	? X 115200 8 None 1 None 1 None K Cancel Apply
Connected 0:00:02 Auto detect Auto detect SCRG	OLL CAPS NUM Capture Print echo	



HyperTerminal Example Opening a Virtual Com Port

USB Human Interface Device (HID) Bridges

- Performs bridging between USB and another communications interfaces such as UART or SMBus\I2C
- HID is a defined USB class that operating systems support natively
 - The end customer does not need to install drivers
- The HID class definition is flexible enough to accommodate many different kinds of USB designs
- Requires no driver install since it uses the HID class
- Host applications use an API to access the low level HID driver



HID Representation

Single-Chip USB to UART Bridge Diagram





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USB Solutions Features and Benefits

- VCP and HID drivers enable device operation as USB to UART bridge devices
- USBXpress development kit provides a complete host and device software solution
- No USB protocol or host device driver expertise is required

CP21xx Features	Customer Benefit
HID-USB support (CP2110 and CP2112)	 No driver installation required Seamless compatibility with most operating systems
Highly integrated solution	 Reduces BOM cost by eliminating Quartz crystal External memories Reduces PCB space
Production ready royalty-free drivers	 Shortens time to market Reduces software development expertise requirements







Regulator (





USB Software Support

Fixed-function driver support

- Full royalty-free drivers for Windows, MAC OS, and Linux
 - VCP, USBXpress
 - WHQL certified
- Full HID compliance

Host Support Software

- VCP
 - Enables existing host applications using com port interfaces to be used without modification
- HID
 - USB HID API to simplify host application development
- USBXpress
 - Allows implementation of USB applications without USB expertise
 - Royalty-free, customizable Windows certified device driver





CP21xxEK





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USB Interface Devices

Silicon Labs USB Connectivity Bridge Solutions



- CP21xx enable USB connectivity to be easily added to any application
- Highly integrated solutions reduce cost, simplify design and shorten development time
- USB expertise is NOT required
- HID-USB solutions provide the ultimate "plug and play" experience



CP2104 Product Overview

CP2104 USB to UART bridge

- USB 2.0 compliant; full speed
- Crystal-less operation
- UART baud rates: 300 bps to 2 Mbps
- In-system programming memory (1024 B)
- 4 GPIO support

- Royalty-free VCP drivers
- USBXpress support
- RS-485 mode support
- QFN24 packages



CP2105 Product Overview

CP2105 USB to DUAL UART bridge

- USB 2.0 compliant; full speed
- Crystal-less operation
- RS-485 mode support
- Up to 5 GPIO support
- Royalty free VCP drivers

- USBXpress support
- Enhanced UART baud rates: 300 bps to 2Mbps
- Standard UART baud rates: 2400 bps to 921600 bps
- In-system programming memory (296 B)
- QFN24 packages



CP2110 Product Overview

CP2110 HID-USB to UART bridge

- USB 2.0 compliant; full speed
- Crystal-less operation
- UART baud rates: 300 bps to 1Mbps
- In-system programming memory (343 B)
- 10 GPIO support

- HID fully compliant
- RS-485 mode support
- QFN24 packages



CP2110 HID Development Flow

The CP2110 is an HID class device

- HIDs communicate with a USB host through the use of reports
 - AN434 is a specification for the reports supported by the CP2110 and describes the configurable parameters
- HID host applications use API calls to transfer data via the defined reports
 - AN433 defines the host API functions





CP2112 Product Overview

CP2112 HID-USB to SMBus\I2C/I²C bridge

- USB 2.0 complaint; Full Speed
- Crystal-less operation
- SMBus\I2C / I²C configuration options support
- 8 GPIO support

- HID fully complaint
- In system programming memory (194 B)
- QFN24 Packages





CP2112 HID Development Flow

The CP2112 is an HID class device

- HIDs communicate with a USB host through the use of reports
 - AN495 is a specification for the reports supported by the CP2112 and describes the configurable parameters
- HID host applications use API calls to transfer data via the defined reports
 - AN496 defines the host API functions





Example HID Host Application

Example API calls shown for retrieving device information

- APIs are part of the precompiled SLABHIDtoSMBus\I2C library as shown
- The host application calls functions to perform all communications with the device via USB

```
void CHidSmbusExampleDlg::UpdateDeviceInformation(BOOL connected)
                     £
                         \prime\prime\prime If we're already connected to the device, then we can call the
                         // opened version of the device information functions
                         if (connected == TRUE &&
                             HidSmbus IsOpened(m hidSmbus, &opened) == HID SMBUS SUCCESS &&
                             opened == TRUE)
                         {
                             // Update device information (opened)
                             if (HidSmbus_GetOpenedAttributes(m_hidSmbus, &vid, &pid, &releaseNumber) == HID_SMBUS_SUCCESS)
                                 vidString.Format(_T("%04X"), vid);
                                 pidString.Format(_T("%04X"), pid);
                                 releaseNumberString.Format( T("XX.X02X"). HIBYTE(releaseNumber), LOBYTE(releaseNumber));
                             if
                                (HidSmbus GetPartNumber(m hidSmbus, &partNumber, &version) == HID SMBUS SUCCESS)
  Name 🔺
 🗐 ReadMe.txt
                                 partNumberString.Format(_T("%d"), partNumber);
                                 versionString.Format(_T("%d"), version);
 h] SLABCP2112.h
   SLABHIDtoSMBus.lib
                             if (HidSmbus_GetOpenedString(m_hidSmbus, deviceString, HID_SMBUS_GET_SERIAL_STR) == HID_SMBUS_S
                                 serialString = deviceString;
                             if (HidSmbus_GetOpenedString(m_hidSmbus, deviceString, HID_SMBUS_GET_PATH_STR) == HID_SMBUS_SUC
                                 pathString = deviceString;
                             if (HidSmbus_GetOpenedString(m_hidSmbus, deviceString, HID_SMBUS_GET_MANUFACTURER_STR) == HID_S
     Host API Call Examples sturerString = deviceString;
                                (<u>HidSmbus_GetOpenedString(m_hidSmbus</u>, deviceString, HID_SMBUS_GET_PRODUCT_STR) == HID_SMBUS_
                             if
                                 productString = deviceString;
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```

HID SMBus\I2C Example for CP2112

Transfer SMBus\I2C data using USB HID

 Highlights functions in the API defined by AN496: CP2112 HID USB To SMBus\I2C API Specification

Example read using the tool

- Connect to the device
- Type the slave address and then click read request
- Check the status by clicking get/write transfer status and verify it completed
- Click get read response
- Click force read response until you get all of your data

DO19AEOE			Disconnect Reset	
Device Informati	on			
Vendor ID:	10C4	Release Nu	Jumber: 0.00	
Product ID:	EA90	Part Nu	Jumber: 12 Version: 1	
Path:	\\?\hid#vid_1	Oc4&pid_ea	a90#682745c87f8080000#{4d1e55b2-f16f-11cf-88cb-001111000030}	
Manufacturer:	Silicon Labora	tories		
Product:	CP2112 HID U	JSB-to-SMBi	3us Bridge	
Serial:	0019AE0E			
- 0 - v - F	ata Transfor			
onfiguration	ata mansier	Pin Configu	juration Customization	
Read Reques	t	_	Addressed Read Request	
Slave Addre:	ss: FO	(Hex)	Slave Address: F0 (Hex)	
Bytes to Rea	ad: 1		Size of Target Address: 2 bytes	
			Target Address: 0000	
R	ead Request		Bytes to Read: 1 Address Read Request	
Read Respons	se			
Received Da	ta:			
Bytes to Rea	ad: 1		Force Read Response Get Read Response	
Write Reques	t			
Data to Wri	te:			
Slave Addre	ss: F0	(Hex)	Write Request	
Transfer Status				
			Cancel Read/Write Transfer Get Read/Write Transfer Status	





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Customization and Certification

CP210x Customization Options

CP210x drivers (using AN220, Windows only)

- Product and company strings
- VID and PID
- Filenames and installation locations

CP210x/CP211x device

- EEPROM/EPROM settings (VID, PID, Serial Number, etc)
- Baud rate aliasing and timeouts (CP2102/3 only) (AN205)
- GPIO and Port Configuration (CP2103 only) (AN223)
- Silicon Labs programming option available (1k min. order)

Request a PID—1 per product

- For use with Silicon Labs VID
- Free-of-charge
- Contact MCU applications for more information: http://www.silabs.com/RequestPID
- Ensures two CP210x drivers will not conflict



USB Driver Customization (1 of 5)

Download AN220 and the software for both USBXpress and VCP driver >

https://www.silabs.com/products/mcu/Pages/ApplicationNotes.aspx



Customize the fields (VCP shown) \geq



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USB Driver Customization (2 of 5)

Select the target Windows version

Enter customer specific data in the associated fields (Silicon Labs data shown)





USB Driver Customization (3 of 5)

Verify the install will cover all devices

Able to add or remove devices for install

Enter the VID and PID for the selected devices

VID obtained from USB.org or use the Silicon Labs VID and assigned PID

Custom US	B Driver Installation Wizard	Add VID/PID/Device Name to Installation		
	General Device Installation Description: CP210x USB to UART Bridge	Device Type: © CP2101/2/3/4 CP2105 		
		VID (Vendor ID): PID (Product ID):		
l je z		10C4 EA70		
Driv	Device List (VID - PID - Device Name):	Example: 10C4 (Hex value) Example: EA60 (Hex value)		
	10C4 - EA60 - Silicon Labs CP210x USB to UART Bridge	Enhanced Interface Device Name:		
100 5	TUC4 - EA7U - Silicon Labs Dual CP2T0x USB to UART Brit	Silicon Labs Dual CP210x USB to UART Bridge: Enhanced (
		Example: "CP210x USB to UART Bridge" (Name appears in Device Manager under the Ports tab)		
1 2 1		Standard Interface Device Name:		
	Add Remove	Silicon Labs Dual CP210x USB to UART Bridge: Standard C		
	Cancel < Back Next >	Save Cancel		



USB Driver Customization (4 of 5)

- Clicking "Next" moves through the configuration process
- The customization driver installer files can be stored in any directory
 - User then runs the saved installer

Custom USB D	Priver Installation Wizard
USB Driver ion Wizard	Product Name: Silicon Laboratories CP210x USB to UART Bridge Example: "Silicon Laboratories USB to UART Bridge" (Name appears in Add/Remove Programs listing) Name for Installation File:
ata	CP210xVCPInstaller
Custor Install	Example: "CP210xVCPInstaller" (Name will show up in the driver installation as CP210xVCPInstaller.exe)
	Cancel < Back Next >

Custom USB D	river Installation Wizard	×
Custom USB Driver Installation Wizard	Device Options ✓ Serial Enumeration Support Serial enumeration will allow Windows to "enumerate device connected to the CP210x (such as serial mice external modems). If your device always presents de PC (such as a GPS device) then disable this to previserial enumerations. ✓ Selective Suspend Support Timeout Value: 10000 ms Selective suspend will put the device to sleep if it habeen opened over a certain timeout value. This is us save power on the PC, and is recommended unless CP210x needs to be powered even if a handle to the is not opened.	e" a ;e or sta to the rent false sen't sed to your e device
Custom USB Driver Installation Wizard	river Installation Wizard Installer Options 2 ♥ Display GUI window during Install 2 ♥ Copy Files to Target Directory during Install 2 Use Target Directory relative to the user's Program Files 2 Target Directory: C:\Program Files\ Silabs\MCU\CP210x\ Example: ''C:\Program Files\SiLabs\Product Note: This MUST be different for each product re Uninstaller Options 2 ♥ Display GUI window during Uninstall 2 ♥ Remove Files from Target Directory during Uninstall	▼ Name\'' eleased.

USB Driver Customization (5 of 5)

Summary of selections can be identified at the end of the configuration process

Can go back and modify settings if required





Fianl Screen with Complete Settings



USB Driver Customization Files



MfgName="silicon Laboratories" Disk_Description="silicon Labs USB to UART Bridge Installation Disk" USB\VID_10C4&PID_EA60.DeviceDesc="silicon Labs CP210x USB to UART Bridge" silabser.SvcDesc="silicon Labs CP210x USB to UART Bridge Driver" silabenm.SvcDesc="silicon Labs CP210x USB to UART Bridge Serial Port Enumerator Driver" PortsClassName = "Ports (COM & LPT)"

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CP210x Device Customization

> Download AN144 for basic EEPROM/EPROM settings (VID, PID, etc.)

https://www.silabs.com/products/mcu/Pages/ApplicationNotes.aspx





CP2110 Set IDs

Utility to program device CP2110 device configuration

- One time programmable configuration
 - Can lock device programming
- Automatically scans for connected devices
- Populates fields when user selects the connected device

CP2110 Set IDs	CP210x 0	Const	omiration	• O ==	Fine	
e Help						
Device Selection						
Device Path: \\?\hid#	npq0006&col01#3&181d53b7&0&	0000#{4d1e55	ib2-f16f-11cf-88cb-001111000030}			
Get De	vice Customization Reset Dev	vice		Part Numb	ber:	Version: 0
Device Customization USB Configuration						
Vendor ID (VID): 📃	0000 (2-byte hex)		Release Version: 🔲 0 .	0	(0 - 255)	
Product ID (PID):	0000 (2-byte hex)		Flush Buffers: 🔲 🗌 Flush TX or	Open		
Power:	(0, 250)	-	Flush TX or	Close		
Fower.	0 (0-250) 0	mA	Flush RX or	Open		
Power Mode:	(@) Bus Powered Solf Dewared Veltage Degulation	er Diesklad (M	Flush RX or	1 Close		
	 Self Powered, Voltage Regulat Self Powered, Voltage Regulat 	or Disabled (W	arning: Device will not operate unles	s powered by v	00)	
	O ben i onerea i ronage negata					
String Descriptors						
Manufacturer:						
Product: 📃						
Serial:						
Pin Configuration						
	CPTO Input	CDTO 7:	CPIO Input	Suspend	Lise Su	spend Mode and Values
CPIO 1 (PTS)				Madau	0000	(2 hyte hey)
GPI0.1/RTS:	GPIO Input	GP10.8:	GPIO Input	Mode:	0000	(2-byte nex)
GPIO.2/CTS:	GPIO Input	GPIO.9:	GPIO Input 🔻	Latch Value:	0000	(2-byte hex)
GPIO.3 / RS485:	GPIO Input	TX:	TX Output - Open Drain			
GPIO.4 / TX Toggle:	GPIO Input	Suspend:	Suspend Output - Open Drain 🔻	RS485 Level:	Active I	Low
GPIO.5 / RX Toggle:	GPIO Input	/Suspend:	/Suspend Output - Open Drain 💌		Active	nign
GPIO.6:	GPIO Input	-		CLK Divider:	0	(0 - 255) 24000000 H
		Prevent Furthe	er Programming (Lock all custom field	s)		
			Program Device	N	ote: Each f nce, unless	ield is only programmable already locked.



CP2112 Set IDs

Utility to program device configuration

- One time programmable configuration
 - Each configuration parameter can only be programmed once
- Can lock device programming
- Automatically scans for connected devices
- Populates fields when user selects the connected device

🚰 CP2112 Set IDs						
File Help						
Device Selection						
Device Path: \\?\hid#	#vid_10c4&pid_ea90#6&2745c87f&0&0000#{4d1e55b2-f16f-11cf-88cb-001111000030}					
Get De	evice Customization Reset Device Part Number: CP2112 Version: 1					
Device Customization — USB Configuration —						
Vendor ID (VID): 🔽	10C4 (Hex) Release Version: 1 . 0 (0 - 255)					
Product ID (PID): 🔽	EA90 (Hex)					
Power:	50 (0 - 250) 100 mA					
Power Mode:	Power Mode: Bus Powered Self Powered, Voltage Regulator Disabled (Warning: Device will not operate unless powered by VDD) Self Powered, Voltage Regulator Enabled					
String Descriptors						
Manufacturer: 🔽] Silicon Laboratories					
Product: 🔽	CP2112 HID USB-to-SMBus Bridge					
Serial: 🔽	0019AE0E					
Prevent Further Programming (Lock all custom fields)						
	Program Device Note: Each field is only programmable once unless already locked	e				



WHQL Certification

- WHQL stands for Windows Hardware Quality Labs
- > Benefits:
 - Removes warnings in versions supported by Windows
 - Driver installs when device is connected without Add New Hardware wizard (no user interaction)
- Once drivers are customized (even just VID/PID changed), the original WHQL certification is lost; the customized drivers have to be recertified with Microsoft WHQL
- Contact MCU support for latest information on WHQL certification procedure
- Check out the knowledgebase article that instructs how to proceed with certification

http://cp-siliconlabs.kb.net/article.aspx?article=89180&p=4120





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Development Tools

CP21xx Development Kits

CP21xxEK evaluation kits

- Complete evaluation and customization of the CP21xx USB connectivity bridges
- USB, serial cable(s)
- Documentation
- Downloadable Windows, Mac and Linux drivers



Device	Orderable development kit	MSRP
CP2104	CP2104EK	\$29.00 USD
CP2105	CP2105EK	\$39.00 USD
CP2110	CP2110EK	\$39.00 USD
CP2112	CP2112EK	\$29.00 USD



CP21xx Evaluation Kits

Each device has its own evaluation kit

- Allows for complete evaluation and customization of the CP21xx bridges
 - Includes Windows, Mac and Linux drivers
 - USB and serial cable(s)
 - Full documentation



Available Now !

Device	Orderable Development Kit	MSRP
CP2104	CP2104EK	\$29.00 USD
CP2105	CP2105EK	\$39.00 USD
CP2110	CP2110EK	\$39.00 USD
CP2112	CP2112EK	\$29.00 USD





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Summary

Summary

These new CP21xx products expand on our market-leading portfolio of existing USB bridge devices

- CP2104 USB to UART
- CP2104 USB to Dual UART
- CP2110 HID-USB to UART
- CP2112 HID-USB to SMBus\I2C

Compelling features that are unmatched by any competitor

- USB crystal-less operation
- In-system programming memory
- Small packages
- Complete development ecosystem that includes royalty-free driver suites

HID-USB solutions are only offered by Silicon Labs (CP2110 and CP2112)

- No need for driver installation
- Seamless compatibility with most operating systems





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www.silabs.com/MCU