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\I2C

- **USB Interface device development flow**

- **Customization and certification**

- **Summary**

- **Development tools**

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USB Bridging

USB Interface Devices

➢ **Used as a bridge between communications interfaces**

- Examples: USB to UART, USB to SMBus\I2C

➢ **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

Universal Serial Bus Host

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Embedded MCU Serial Interface

Typical USB to UART Bridge Example
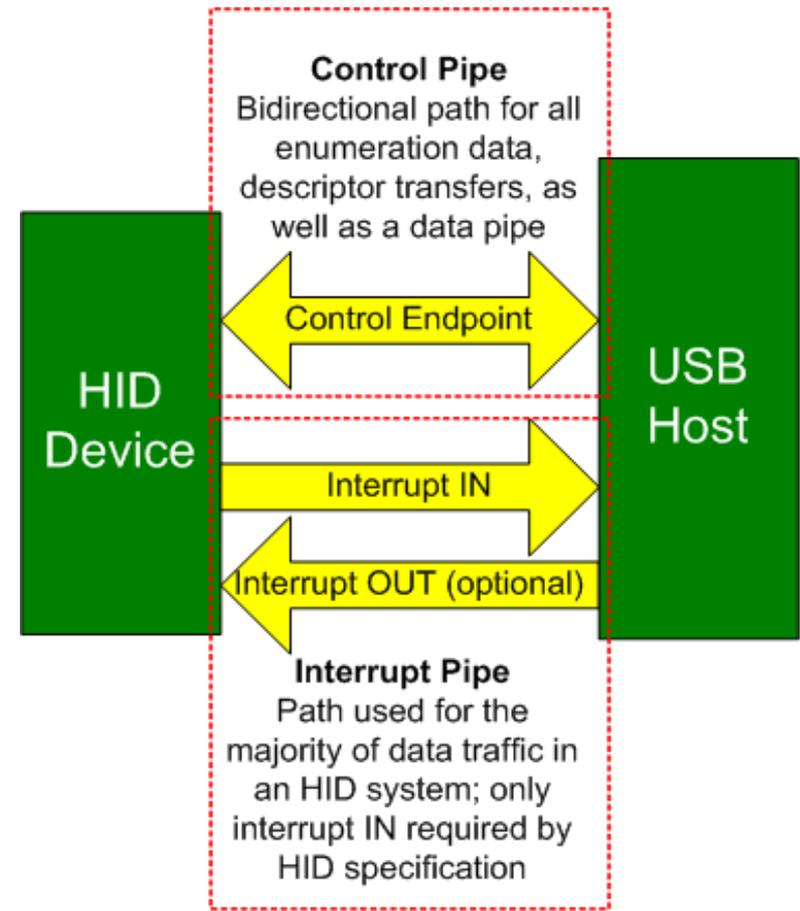
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USB Virtual Com Port (VCP) Bridges

➢ **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**
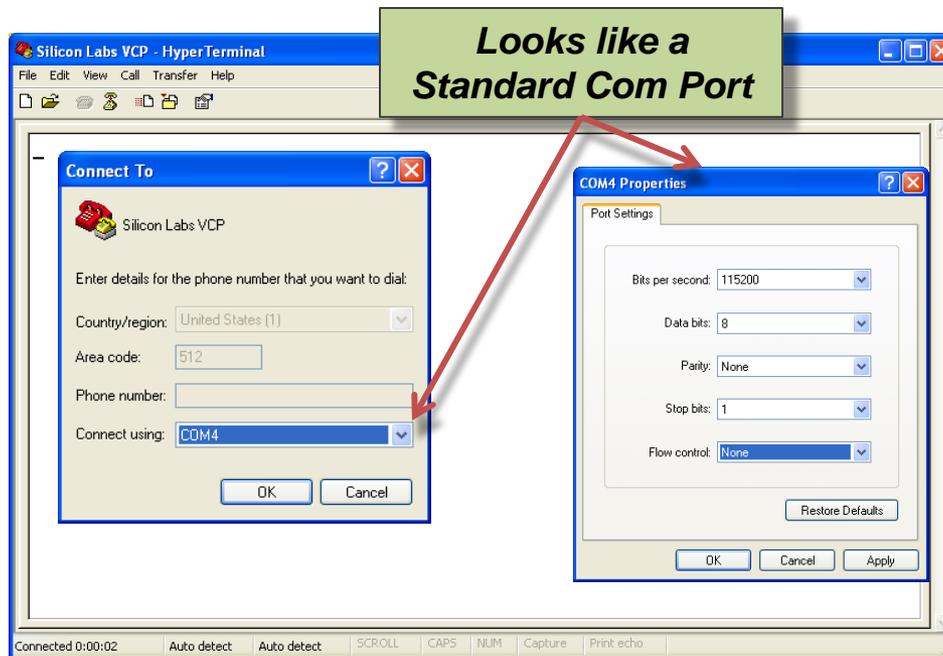
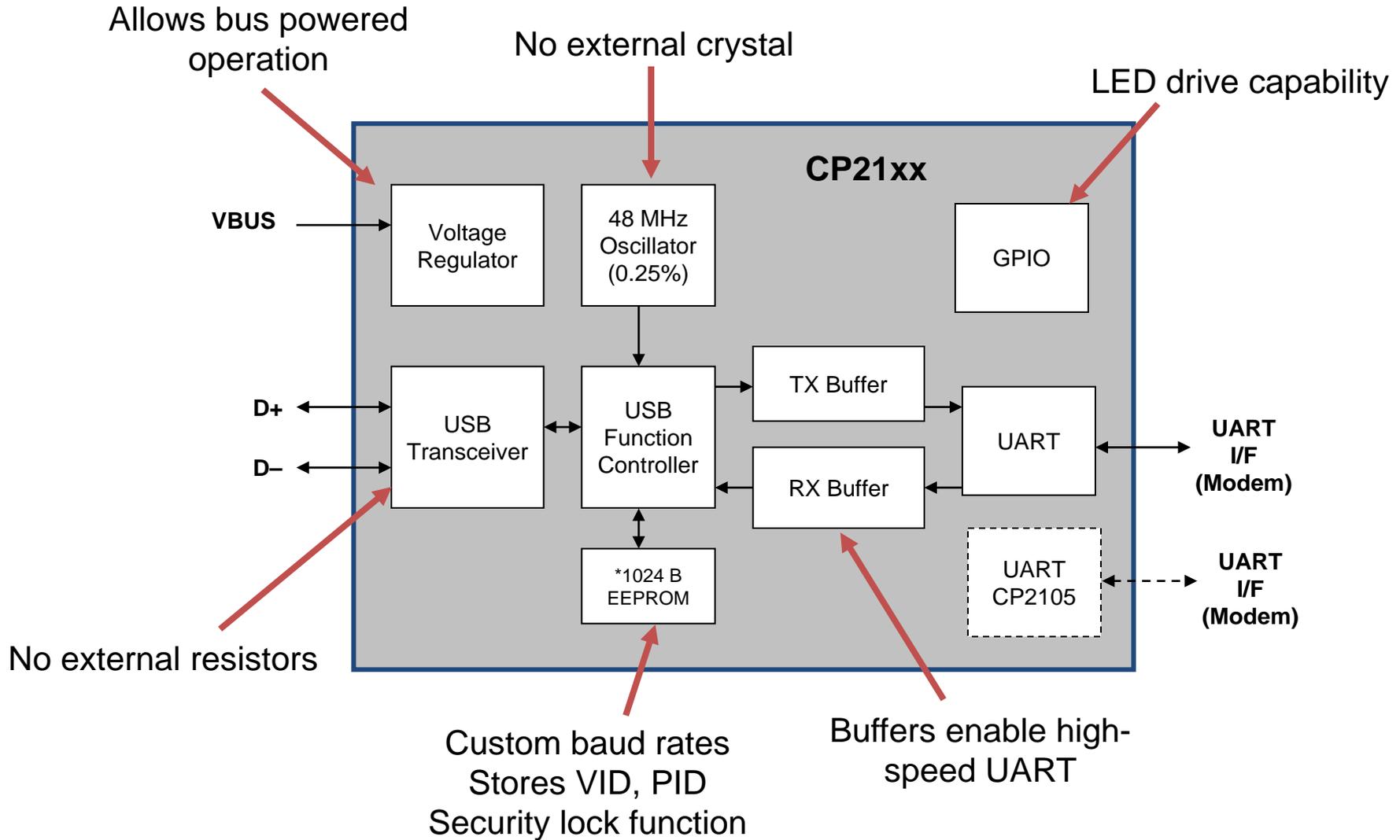*HyperTerminal Example Opening a Virtual Com Port*

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**

Control Pipe
Bidirectional path for all enumeration data, descriptor transfers, as well as a data pipe

Control Endpoint

HID Device

USB Host

Interrupt IN

Interrupt OUT (optional)

Interrupt Pipe
Path used for the majority of data traffic in an HID system; only interrupt IN required by HID specification

HID Representation

Single-Chip USB to UART Bridge Diagram

Allows bus powered operation

No external crystal

LED drive capability

CP21xx

VBUS → Voltage Regulator

48 MHz Oscillator (0.25%)

GPIO

D+ ↔ USB Transceiver ↔ USB Function Controller → TX Buffer → UART ↔ UART I/F (Modem)

D− ↔

RX Buffer ← UART

*1024 B EEPROM

UART CP2105 ⇠ UART I/F (Modem)

No external resistors

Custom baud rates
Stores VID, PID
Security lock function

Buffers enable high-speed UART

*CP2102, CP2103 and CP2104

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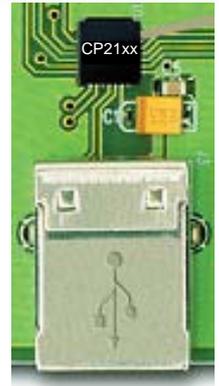
CP21xx Features	Customer Benefit
HID-USB support (CP2110 and CP2112)	• No driver installation required • Seamless compatibility with most operating systems
Highly integrated solution	• Reduces BOM cost by eliminating 　• Quartz crystal 　• External memories • Reduces PCB space
Production ready royalty-free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

EEPROM   Resistors   Crystal   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
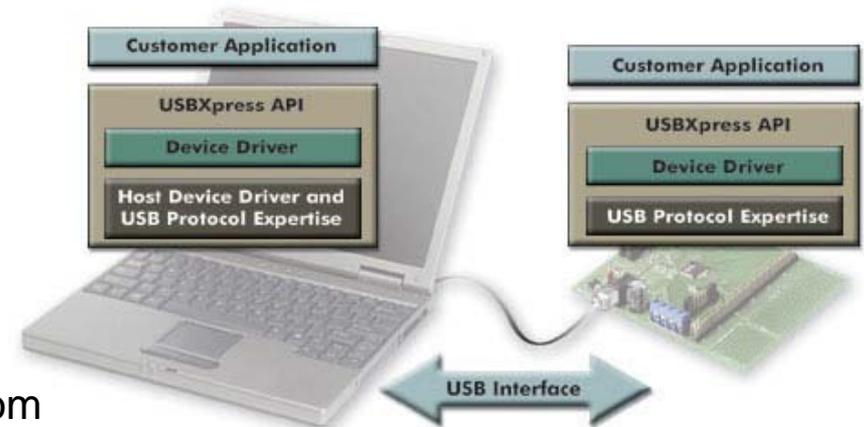
CP21xxEK

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USB Interface Devices

Silicon Labs USB Connectivity Bridge Solutions

USB Crystal-less operation
Fully integrated USB transceiver
In-circuit programming memory
Small packages

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CP21xx

USB to UART
CP2104

USB to DUAL UART
CP2105

HID-USB to UART
CP2110

HID-USB to
SMBus\I2C
CP2112

Royalty-free VCP drivers
USB Express

Fully Complaint HID-USB
operation
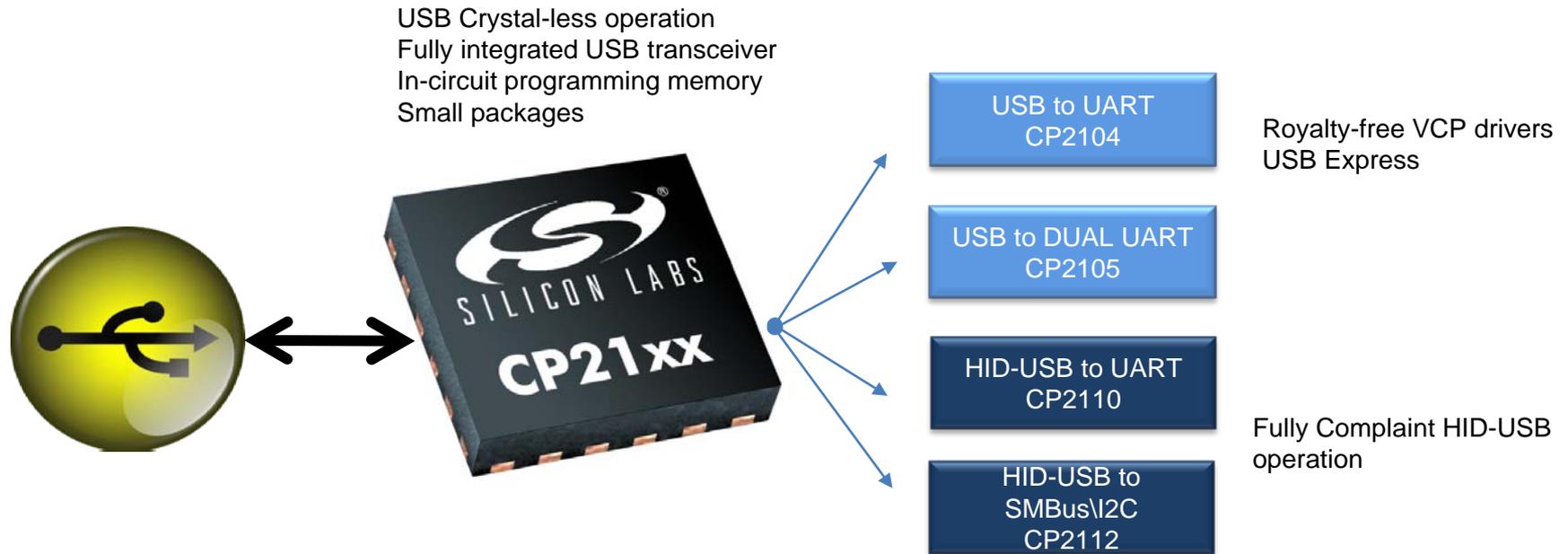
- ➤ **CP21xx enable USB connectivity to be easily added to any application**

- ➤ **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**

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➤ **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

Add 4.7uF cap for PROM programming
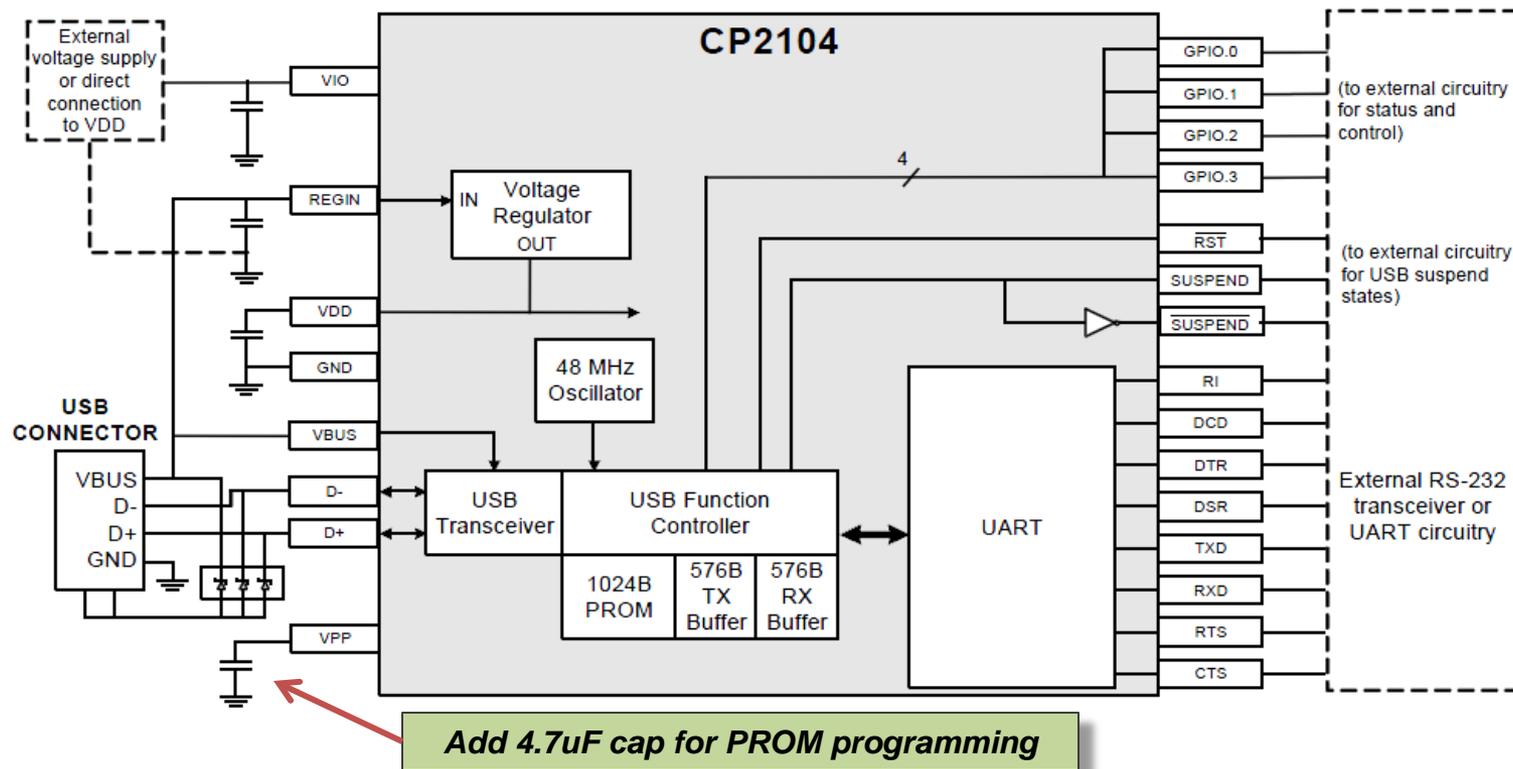
> ## CP2105 USB to DUAL UART bridge

- 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

Add 4.7uF cap for PROM programming
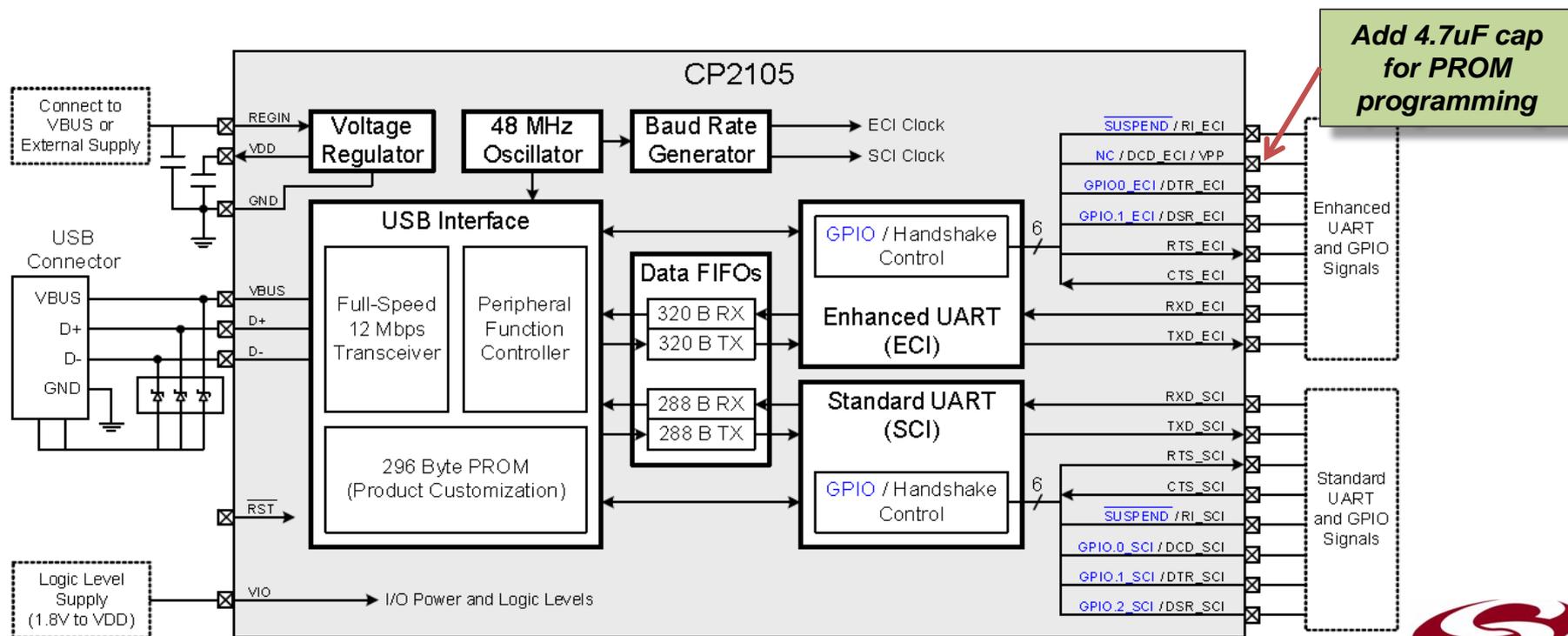
CP2110 Product Overview

➢ **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

Add 4.7uF cap for PROM programming
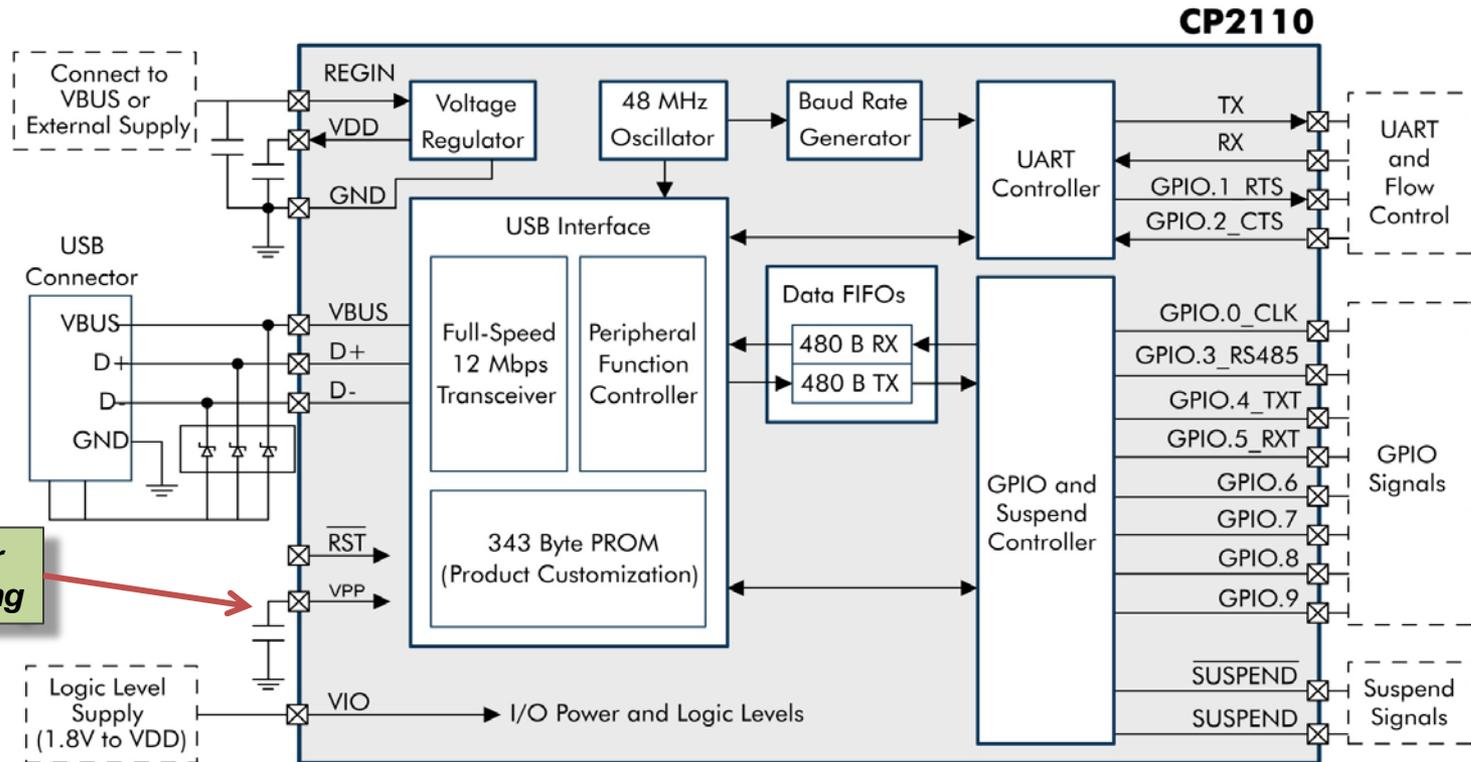
CP2110 HID Development Flow

➢ **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

AN434: Report Specification   *AN433: API Specification*
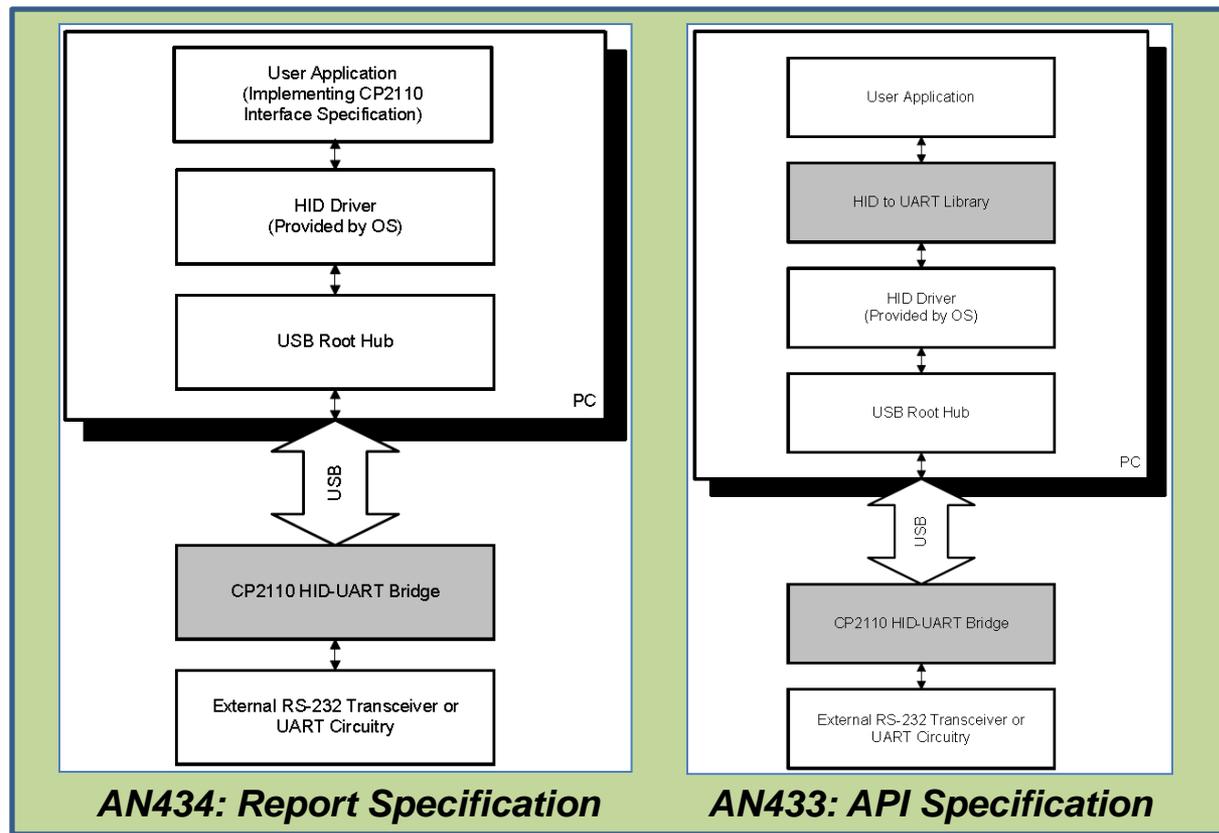
CP2112 Product Overview

➢ **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

Add 4.7uF cap for PROM programming
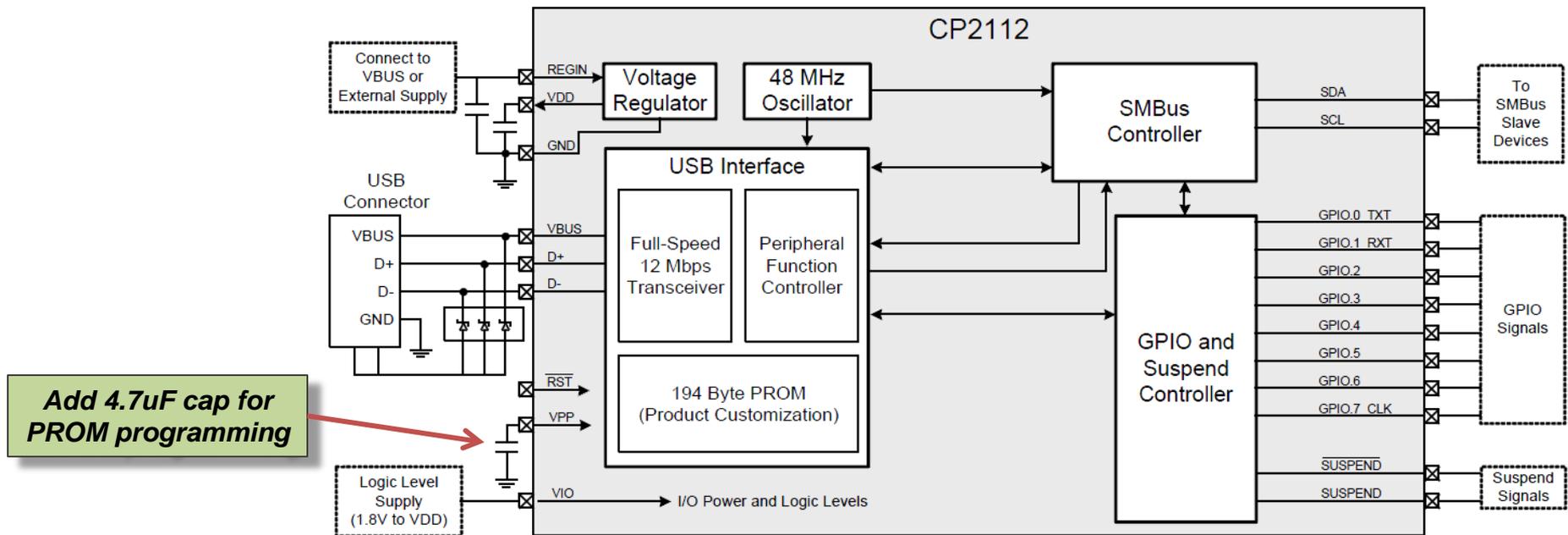
CP2112 HID Development Flow

➢ **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

AN495: Report Specification   *AN496: API Specification*
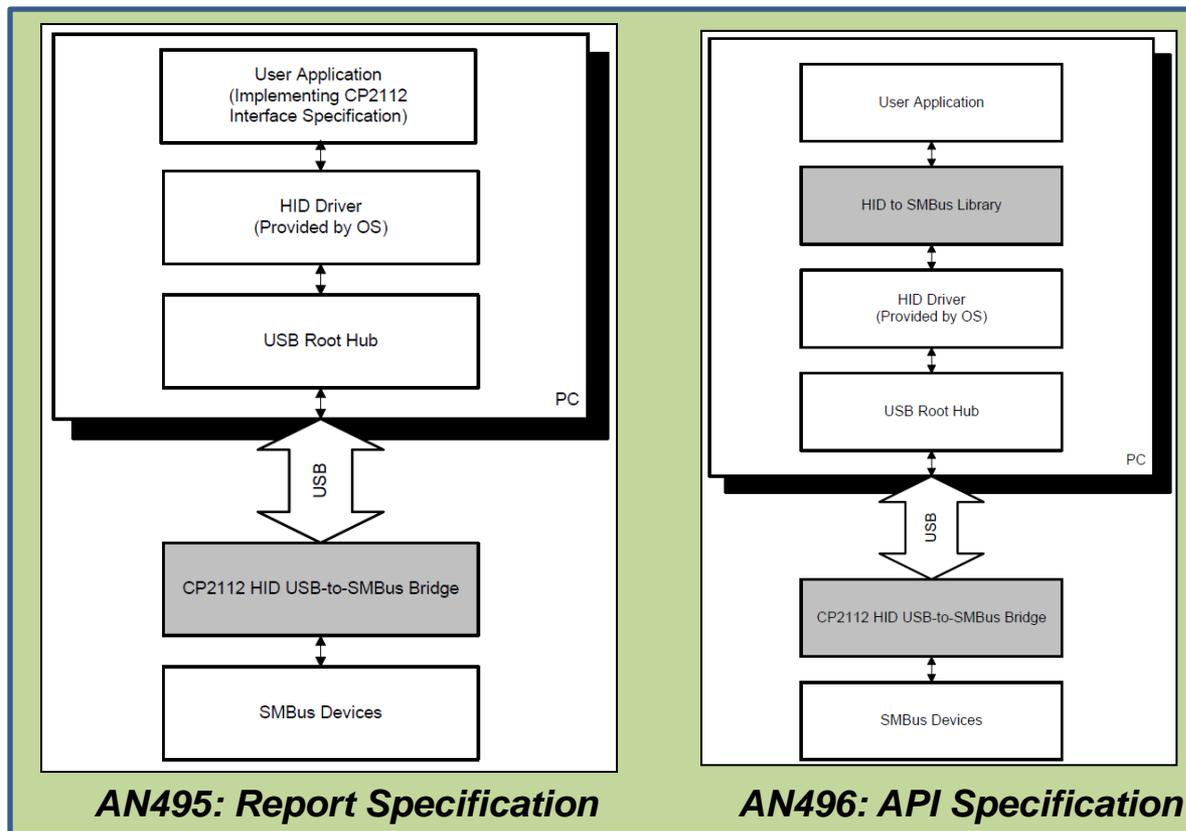
Example HID Host Application

➢ **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)
{
    // 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("%X.%02X"), HIBYTE(releaseNumber), LOBYTE(releaseNumber));
        }
        if (HidSmbus_GetPartNumber(m_hidSmbus, &partNumber, &version) == HID_SMBUS_SUCCESS)
        {
            partNumberString.Format(_T("%d"), partNumber);
            versionString.Format(_T("%d"), version);
        }
        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
            turerString = deviceString;
        if (HidSmbus_GetOpenedString(m_hidSmbus, deviceString, HID_SMBUS_GET_PRODUCT_STR) == HID_SMBUS_
        {
            productString = deviceString;
        }
    }
}
```

Name ▲
- ReadMe.txt
- SLABCP2112.h
- SLABHIDtoSMBus.lib
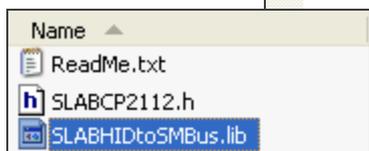
Host API Call Examples

➢ **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

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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

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

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

Communication	CP210x	CP210x Device Customization Guide	AN144	AN144SW
		Serial Communications Guide for CP210x	AN197	AN197SW
		CP210x Baud Rate Support	AN205	AN205SW
		C8051F32x and CP210x USB Driver Customization	AN220	AN220SW

➢ Customize the fields (VCP shown)
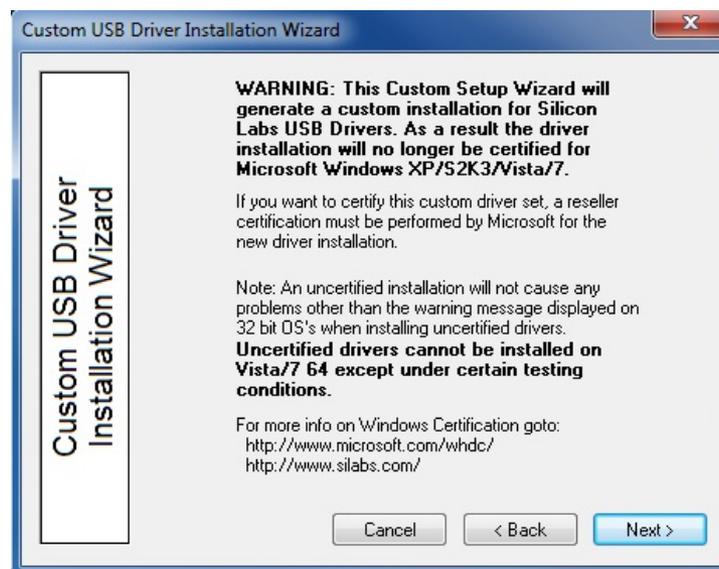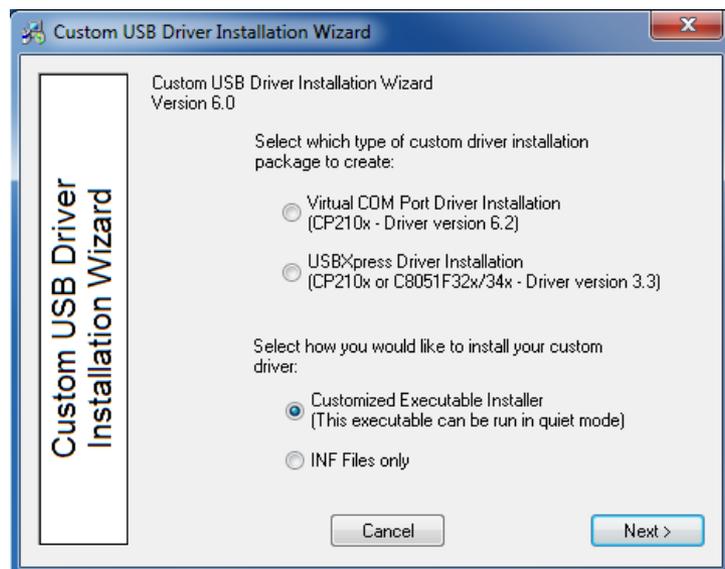
➢ **Select the target Windows version**

➢ **Enter customer specific data in the associated fields (Silicon Labs data shown)**
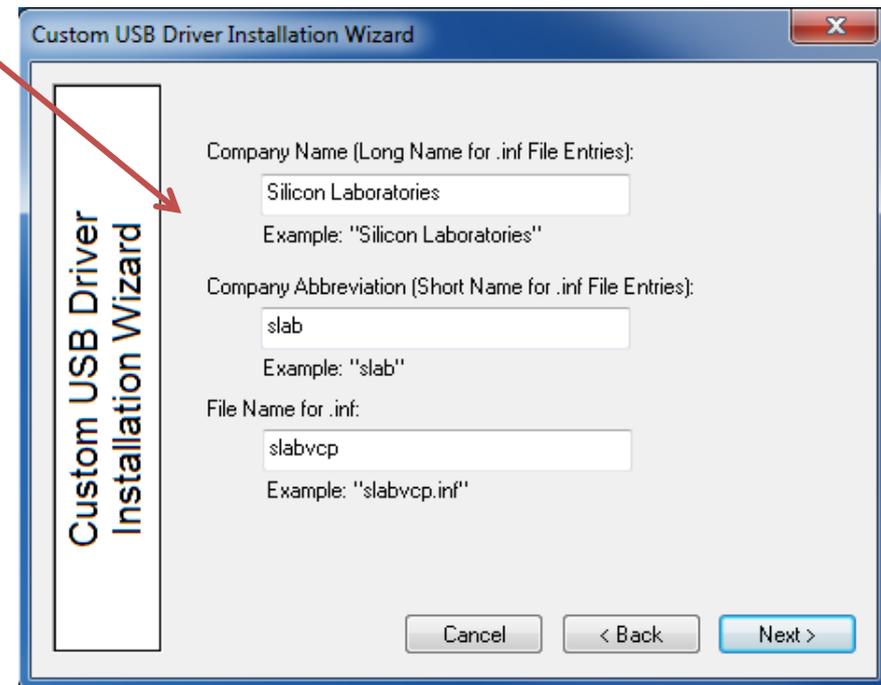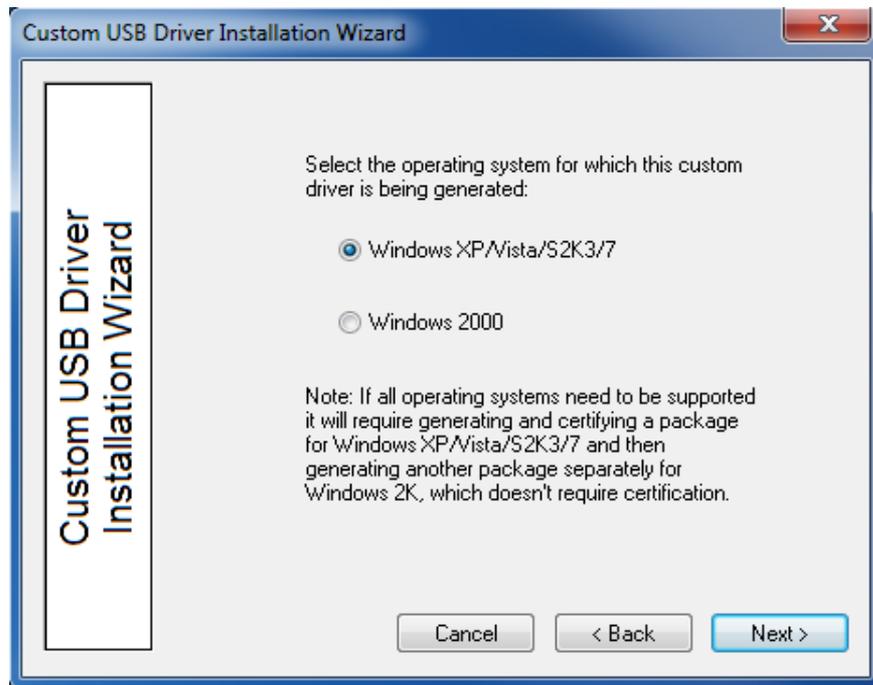
➢ **Verify the install will cover all devices**

- Able to add or remove devices for install

➢ **Enter the VID and PID for the selected devices**

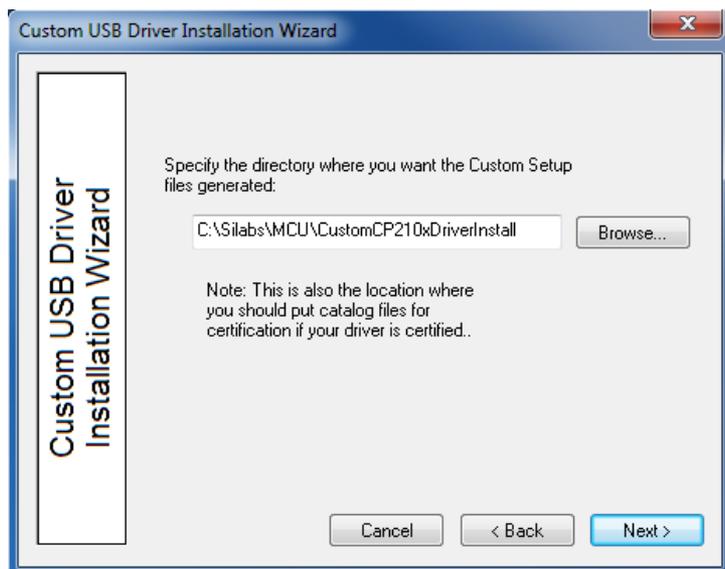- VID obtained from USB.org or use the Silicon Labs VID and assigned PID
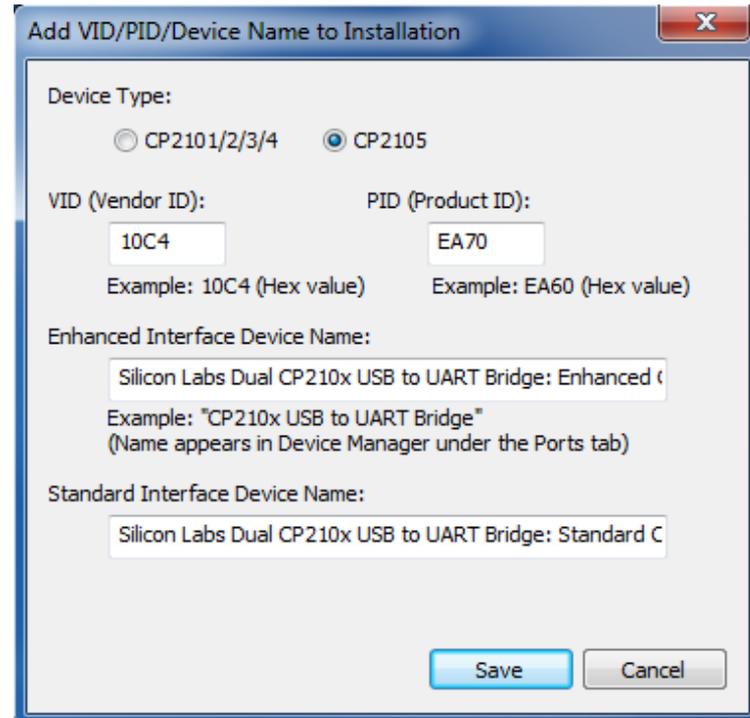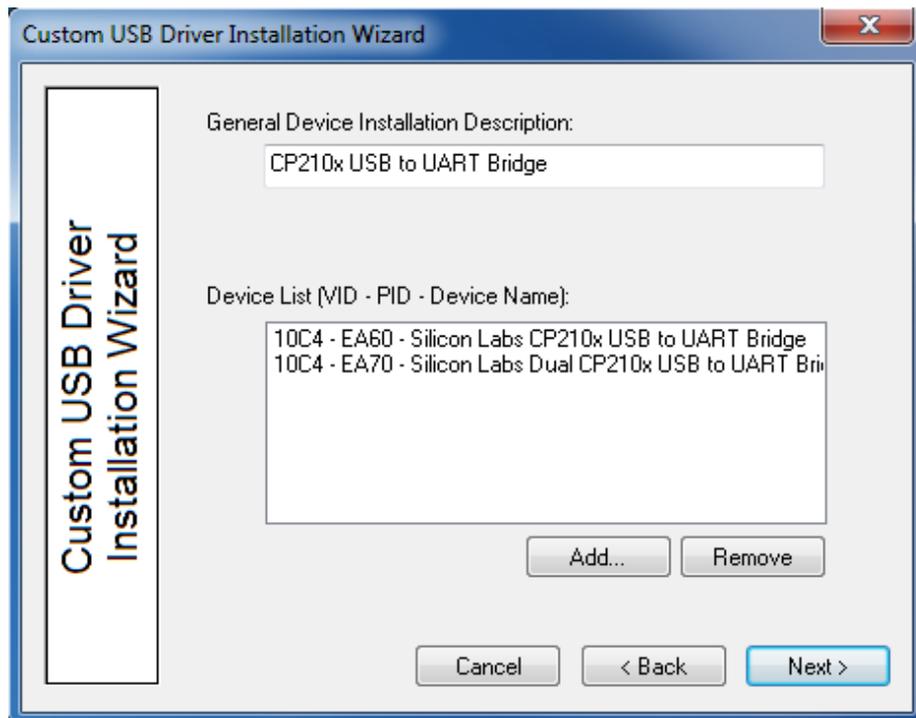
➢ **Clicking "Next" moves through the configuration process**

➢ **The customization driver installer files can be stored in any directory**

  ▪ User then runs the saved installer
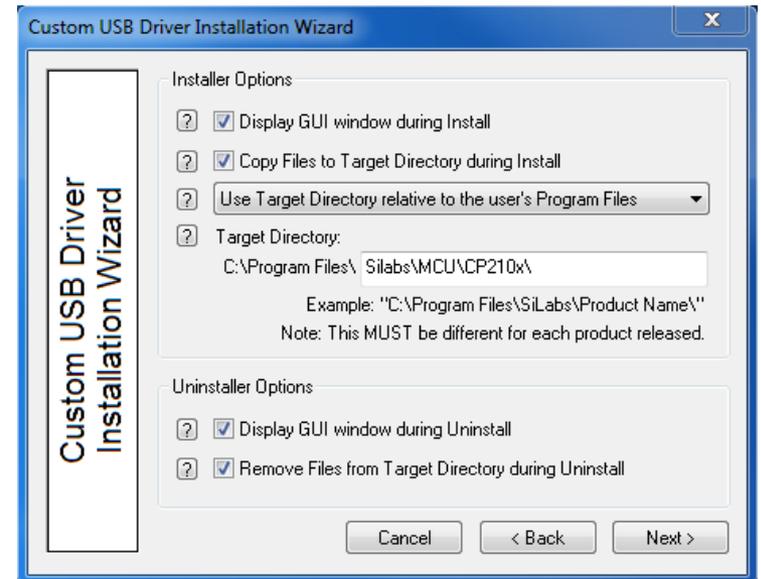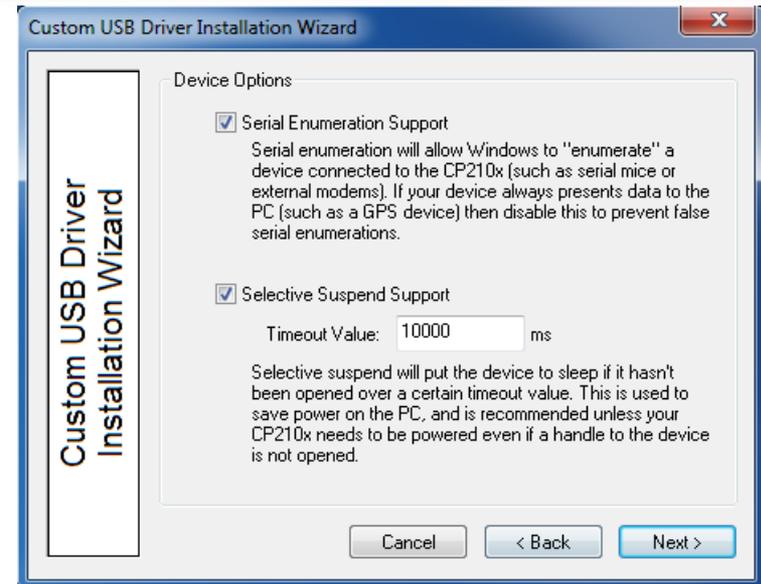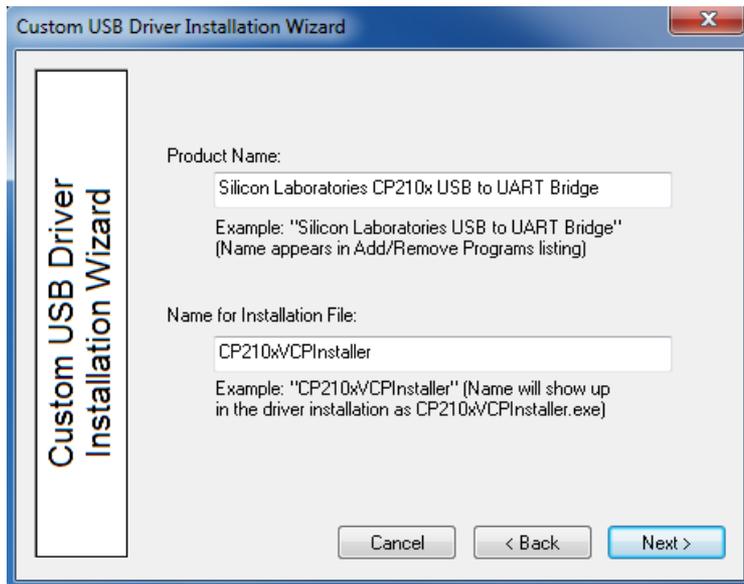
➤ **Summary of selections can be identified at the end of the configuration process**

- Can go back and modify settings if required
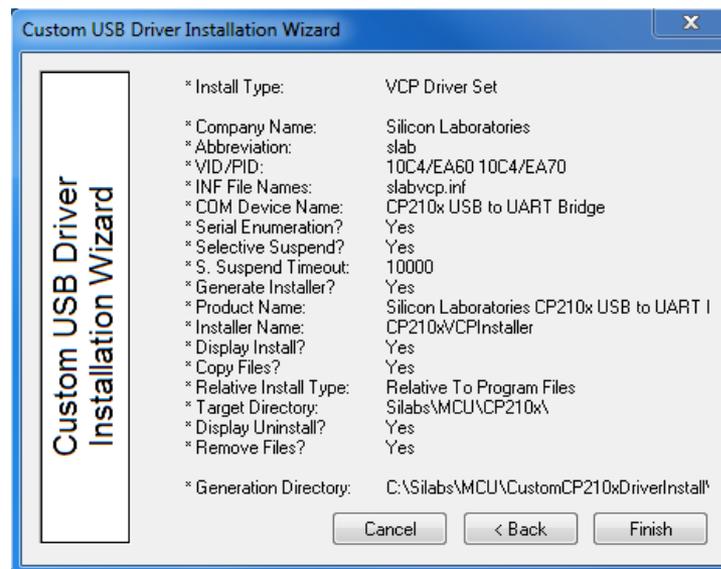
Fianl Screen with Complete Settings
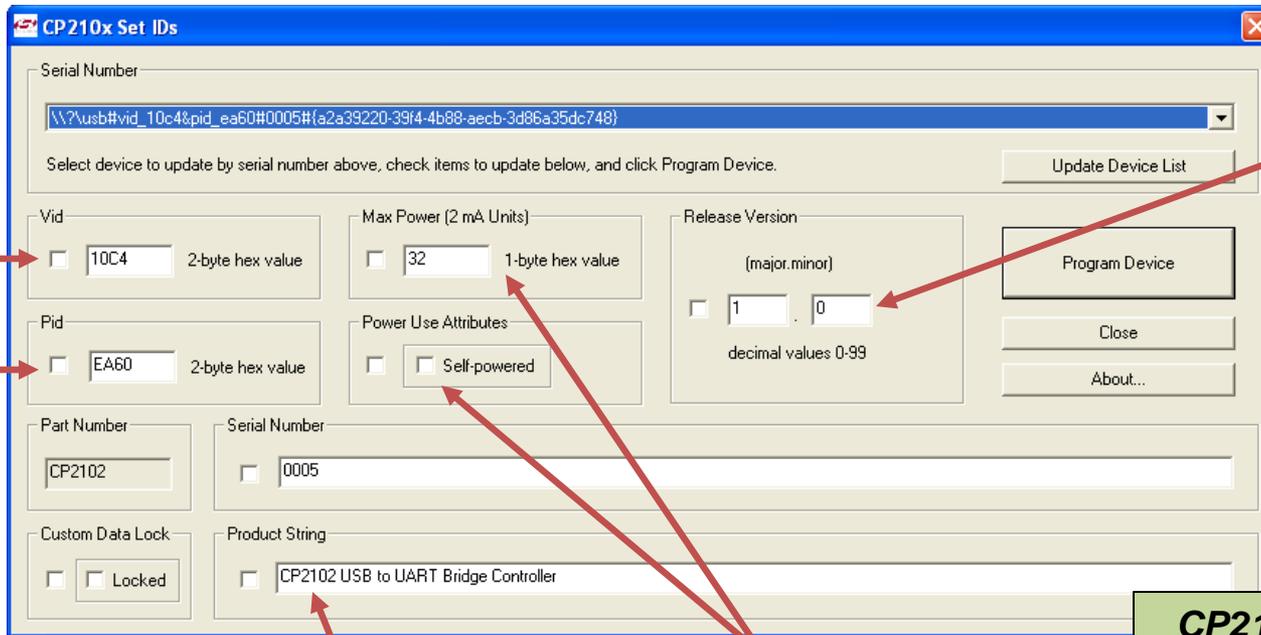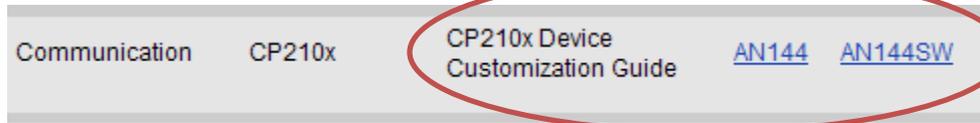
USB Driver Customization Files

```
Silabs
├── EZMac(TM)
├── LoadBoard_2.x_driver
└── MCU
    └── CP210x
        ├── x64
        └── x86
```

```
CustomCP210xDriverInstall
├── x64
└── x86

CP210xVCPInstaller.exe
setup.ini
slabvcp.inf
xyzvcp.inf
```

silabenm.sys
System file
47 KB

silabser.sys
System file
57 KB
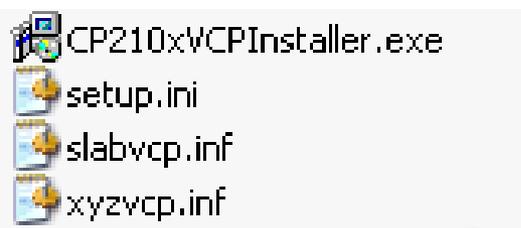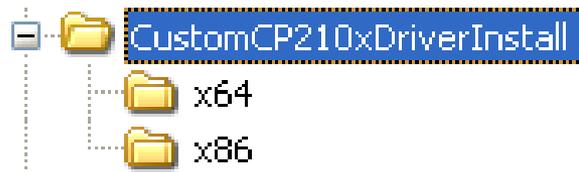
```
[Strings]
Provider="Silicon Laboratories"
MfgName="Silicon Laboratories"
Disk_Description="Silicon Labs USB to UART Bridge Installation Disk"
USB\VID_10C4&PID_EA60.DeviceDesc="Silicon Labs CP210x USB to UART Bridge"
silabser.SvcDesc="Silicon Labs CP210x USB to UART Bridge Driver"
silabenm.SvcDesc="Silicon 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

| Communication | CP210x | CP210x Device Customization Guide | AN144 | AN144SW |

CP210x Set IDs GUI

For customer's use

Must be checked for VID/PID setting to be programmed

Doesn't need to match the driver

Should be adjusted for the application

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

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 GUI

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