CY7C64225

USB to UART Bridge Controller Product Description Guide

Spec. # 001-80740 Rev. **

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Contents

1. Introduction

CY7C64225 is Cypress Semiconductor's Full-speed (12 Mbps) USB to UART Bridge controller supporting data transfer rates from 300 bps to 256000 bps and data format of 8 data bits, 1 stop bit and no parity. CY7C64225 is a fully integrated chip with an internal EEPROM, Oscillator and a voltage regulator that reduces BOM cost. The controller supports bus and self-powered modes, and enables efficient system power management with suspend and remote wake-up signaling. Cypress's proprietary software configuration utility allows configuration of VID, PID, Product string descriptor, and Manufacturer string descriptor. These parameters are stored in EEPROM.

This document details how to configure the controller, install drivers, and interface with external components.

1.1 Collateral Available

The following are the collateral available for download on www.cypress.com/go/UsbtoUart

- WHQL Certified Windows Drivers
- Software Configuration Utility
- Product User Guide
- Product Datasheet

1.2 Functional Overview

CY7C64225 supports the following baud rates and data format

Baud rates (bps): 300, 600, 1200, 2400, 4800, 9600, 14400, 19200, 38400, 57600, 115200 and 256000 bps.

Data Format:

- 8 data bits
- 1 stop bit
- No parity

Note At lower baud rates (300 bps to 2400 bps), UART data transfer is slower than the USB data transfer.

1.2.1 Hardware Reset

Driving the Reset pin of CY7C64225 to logic high resets all internal logic.

1.2.2 Suspend and Resume

When the USB bus is in suspend state, CY7C64225 drives the Suspend pin to logic low and enters into a low power mode. This signal can be used to drive the entire system into low power mode to meet the stringent suspend current requirements of the USB specification, while using in bus

powered mode. The device will resume normal operation whenever any activity is detected on the USB bus, including USB reset signaling.

1.2.3 Wakeup

If Remote wakeup is enabled on the device then asserting this signal generates remote wakeup signaling which when acknowledged by the host will make the device resume normal operations.

1.2.4 Activity Indicators

Tx_LED and Rx_LED are pins that can be used to indicate activity on the TX and RX lines respectively. The chip drives the LEDs directly without any need for external drivers.

1.2.5 VCFG

A logic low on the VCFG pin indicates that the VBUS is detected and the device is in configured state.

1.2.6 VBUS

A 1 kΩ resistor in series is required with VBUS pin in self-powered applications. This pin is used for VBUS monitoring.

1.2.7 UART Interface

CY7C64225 supports hardware flow control using Request-To-Send (RTS) and Clear-To-Send (CTS) pins. CDC (Communications device class) specification does not have a provision to indicate the flow control mechanism to the device. So, even if the Virtual COM port is configured for hardware flow control, the host doesn't have a way to intimate the device about the same. But, CY7C64225 has a special feature that works around this problem by having the hardware flow control always ON and will indicate busy (do not send data) by driving RTS pin to logic high. On the transmit side, it won't transmit data when its CTS pin is driven high.

- For devices that don't support hardware flow control, leave RTS pin of CY7C64225 as No Connect (NC) and connect CTS pin of CY7C64225 to logic low.
- For devices that support hardware flow control, connect RTS and CTS pin of CY7C64225 to CTS and RTS pins respectively of the device.

Figure 1-1. Typical USB to UART Bridge using CY7C64225

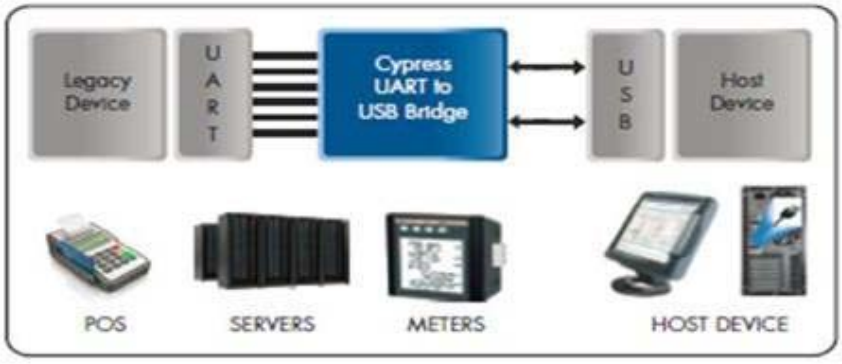


Figure 1-1 shows a typical USB to UART Bridge using CY7C64225. CY7C64225 has been designed to work with not just the Cypress provided royalty free Virtual COM port driver for Windows but also the Microsoft provided Windows serial driver (usbser.sys). This way to migrate a UART based

environment to USB based environment all that is needed is a CY7C64225 based USB to UART serial cable as interconnect. No change in the host application or hardware is needed.

1.3 Driver Description and Setup

CY7C64225 is a fixed function USB to UART controller. CY7C64225 has been designed to work with Windows serial driver (usbser.sys) as well as Cypress's royalty free Virtual COM port driver for Windows. Virtual COM port (VCP) driver causes the USB device to appear as an additional COM port available to the PC. Application software can access the USB device in the same way as it would access a standard COM port. Cypress's USB UART solution eliminates the need for any firmware or software development thereby reducing the customers' time-to-market.

1.3.1 Features

- WHQL Certified for Cypress VID/PID 0x04B4/0x0008
- Supports Windows XP, Vista,7 and 8(both 32-bit and 64-bit)
- Supports Linux, Android and Mac
- Available for download through Cypress website (http://www.cypress.com/go/usb-uart)

1.3.2 Need for the Cypress Driver

Windows inbox driver may have some stability issues when the peripheral is unplugged. To ensure smoother user experience, Cypress provides a Virtual COM port driver.

1.3.3 Driver Installation

The driver files are available for download on Cypress website. The driver package (zip file) has the following files

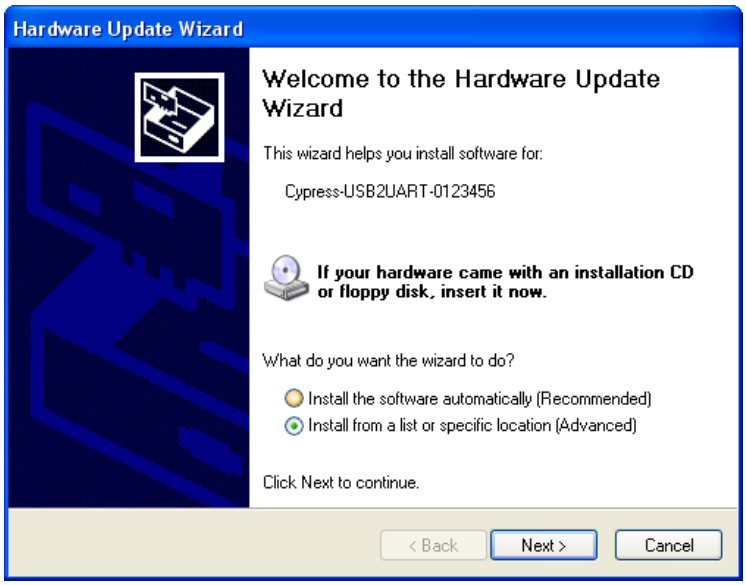
- cypressserial.cat
- CypressSerial.inf
- cypressusbandbus.cat
- CypressUsbAndBus.inf
- CypressUsbConsoleCoInstaller.dll
- CypressUsbConsoleWindowsDriver.sys

These files are WHQL signed for the default VID/PID (0x04B4/0x0008). These files are placed in folders with naming convention in accordance with the OS and CPU architecture (wxp folder has the driver files for Windows XP, wlh-vista has the driver files for Windows Vista and win7 has the driver files for Windows 7 and Windows 8). Within each of these folders the files intended for 64-bit machines are under amd64 folder and the files intended for 32-bit are under x86 folder.

Following are steps involved in installing the driver

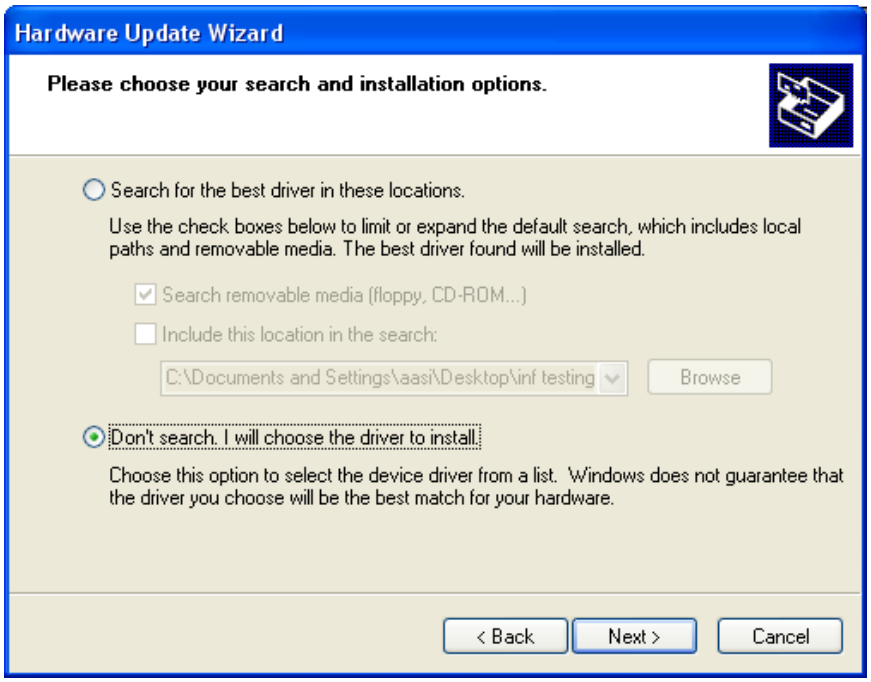
1. Connect the CY7C64225 device to the host PC.
2. Hardware Upgrade Wizard window pop-ups requesting the driver to be used.
3. In the Hardware Upgrade Wizard window select “Install from a list of specific location (Advanced)” and click **Next**

Figure 1-2. Driver Installation Step-1



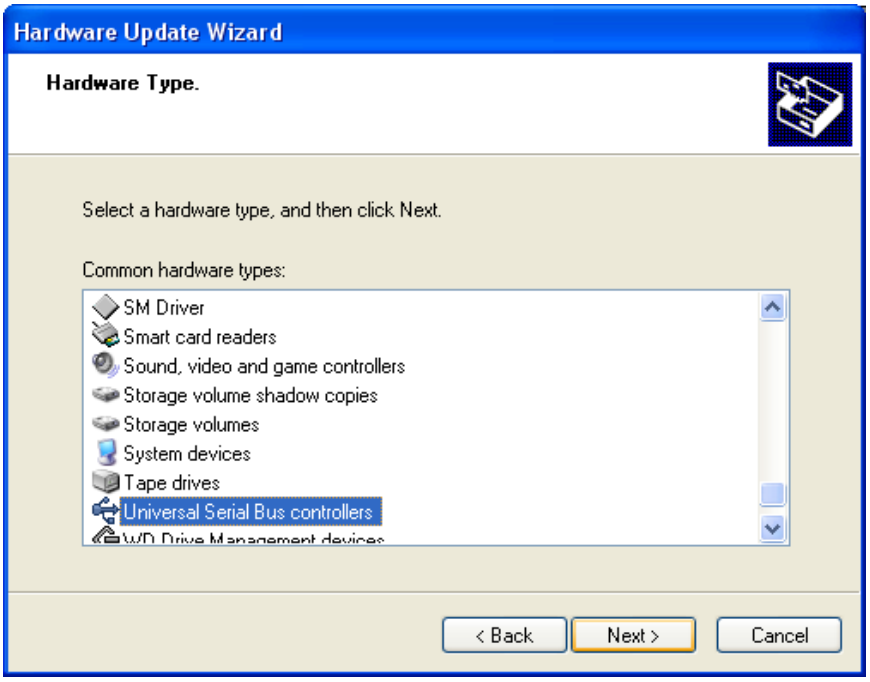
4. Select “Don’t search. I will choose the driver to install” and click **Next**

Figure 1-3. Driver Installation Step 2



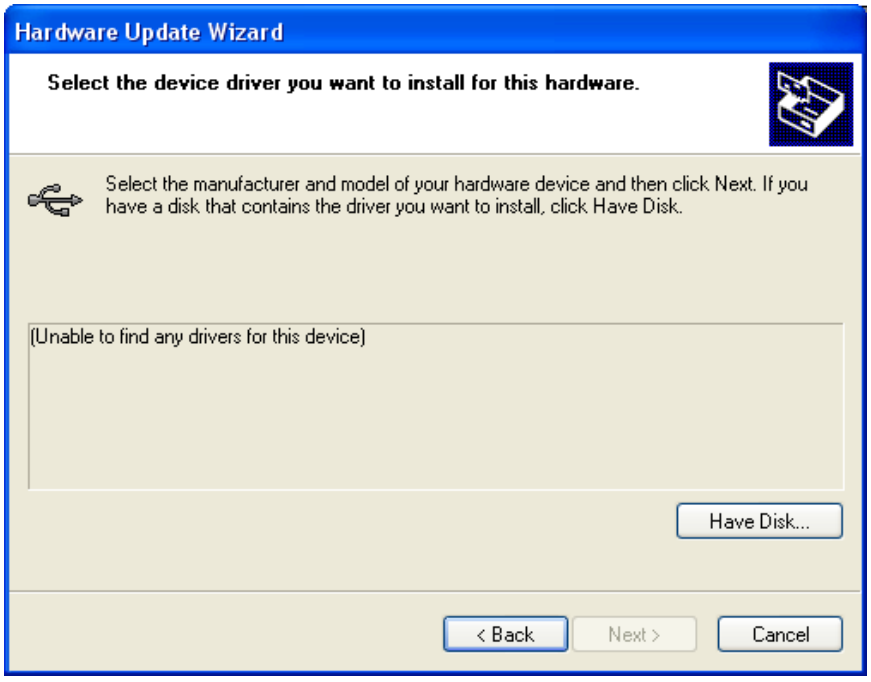
5. Click **Next**

Figure 1-4. Driver Installation Step 3



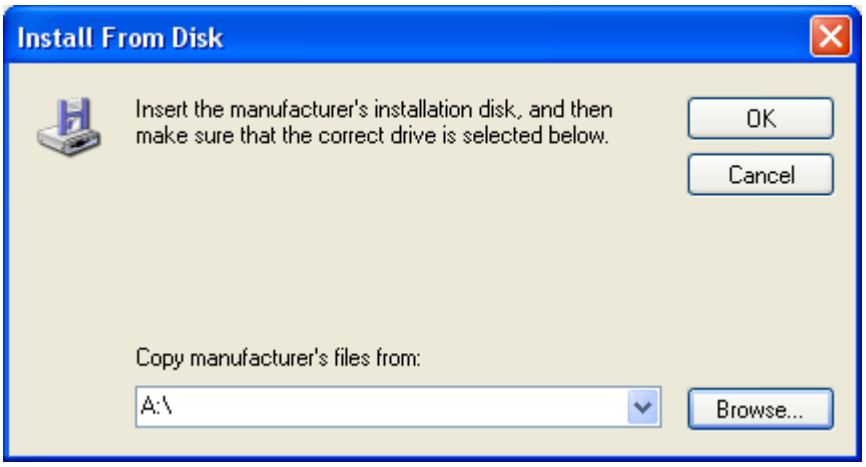
6. Click **Have Disk...**

Figure 1-5. Driver Installation Step 4



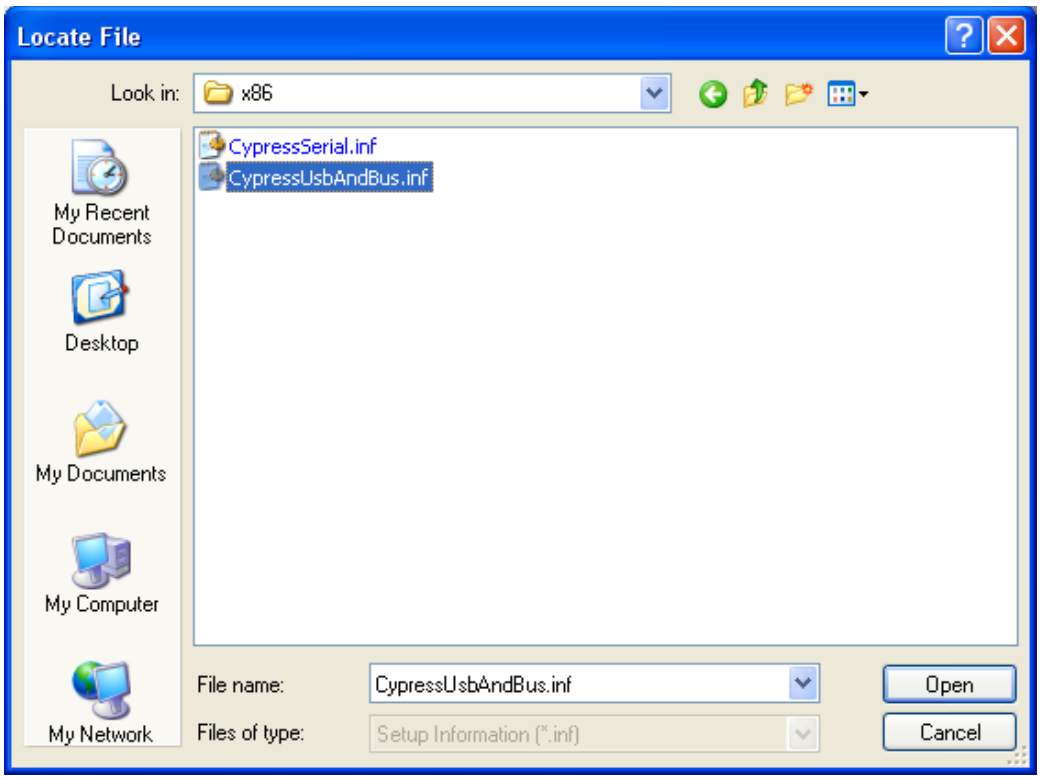
7. Click **Browse**

Figure 1-6. Driver Installation Step 5



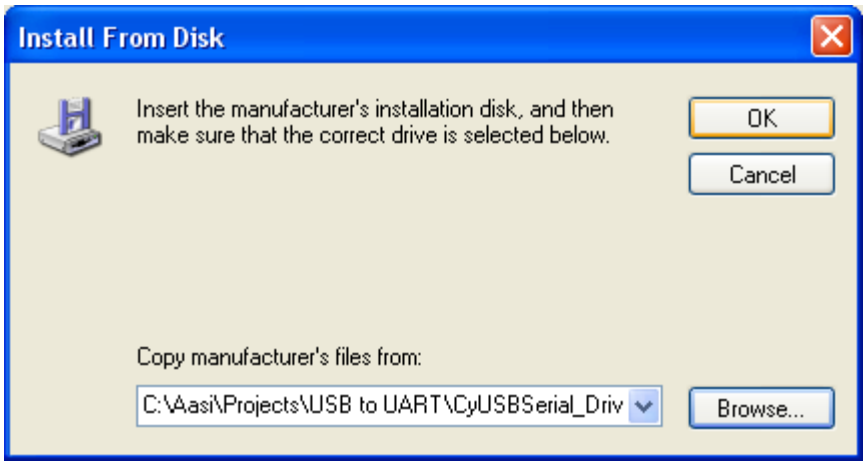
8. Navigate to the location of the driver files (based on the OS and CPU-architecture) and point to CypressUsbAndBus.inf and then click Open.

Figure 1-7. Driver Installation Step 6



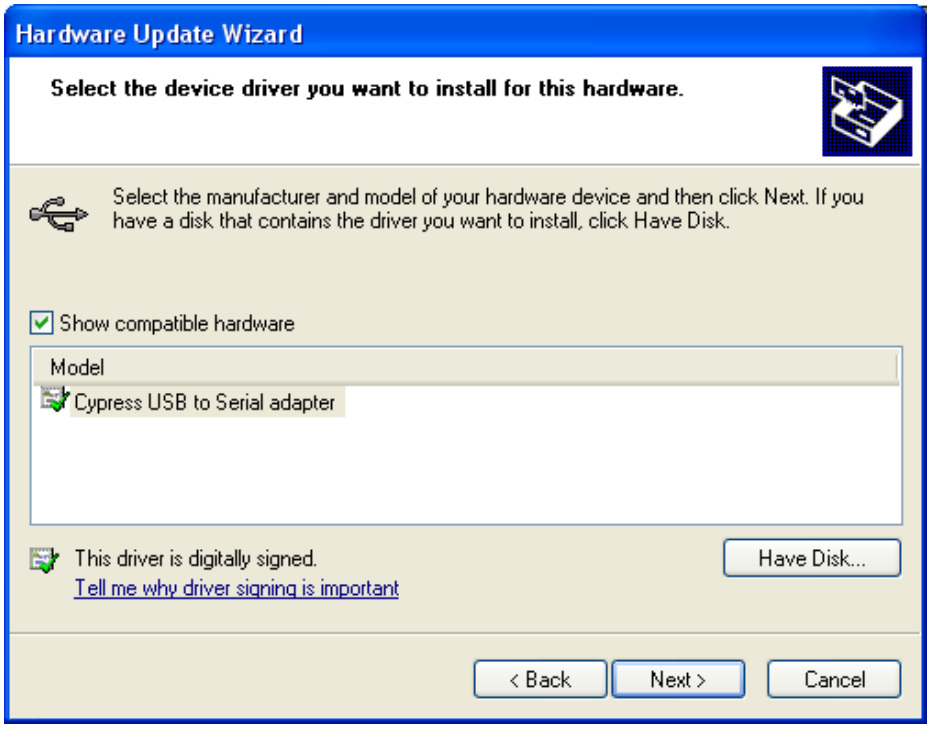
9. Click **OK**.

Figure 1-8. Driver Installation Step 7



10. Now the Model field will show the list of drivers. In this case it will the entry with the name “Cypress USB to Serial adapter” with a signed certificate symbol next to it. This symbol indicates that the driver is digitally signed. Select this entry and click **Next**

Figure 1-9. Driver Installation Step 8



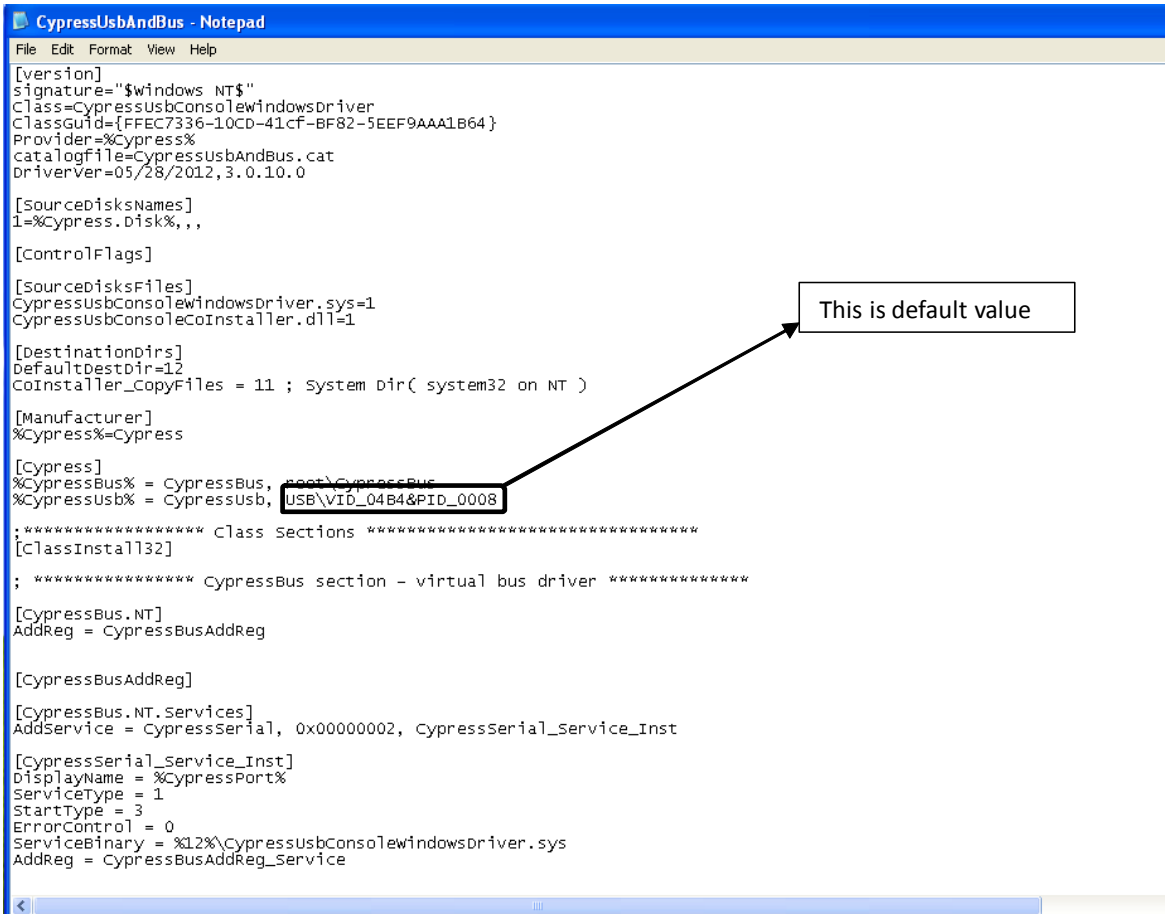
11. The driver files will be copied to the appropriate system folders. Click **Finish**.
12. Follow steps 2 to 11 again and now point to CypressSerial.inf.
13. Now the CY7C64225 USB to UART is ready for use.

1.3.4 Modifying inf File for Windows Operating System

Following are the steps involved in customizing CypressUsbAndBus.inf for your VID/PID

1. Open CypressUsbAndBus.inf using notepad
2. Change the VID/PID with your VID/PID and save the inf file

Figure 1-10. CypressUsbAndBus.inf



Windows Vista and 7 64-bit machines, in normal mode do not allow the usage of unsigned driver.

Modifying the driver files (for instance changing the VID/PID in the inf file) will break the digital signature and the driver will be considered unsigned by the Operating System (OS). The new inf file with the above mentioned change will not work on Windows Vista and win 7 64-bit machines in normal mode. In such scenarios for testing purpose, Press F8 during Operating System (OS) boot-up and select "Disable driver signature enforcement", this enables the loading of unsigned drivers. For production purpose, sign the driver using a trusted thirty-party CA certificate or certify the driver through WHQL.

Note: The "Disable driver signature enforcement" is not a permanent change to the OS boot-up sequence so if unsigned driver is used then the above step has to be repeated for every boot-up.

1.4 Configuration Utility

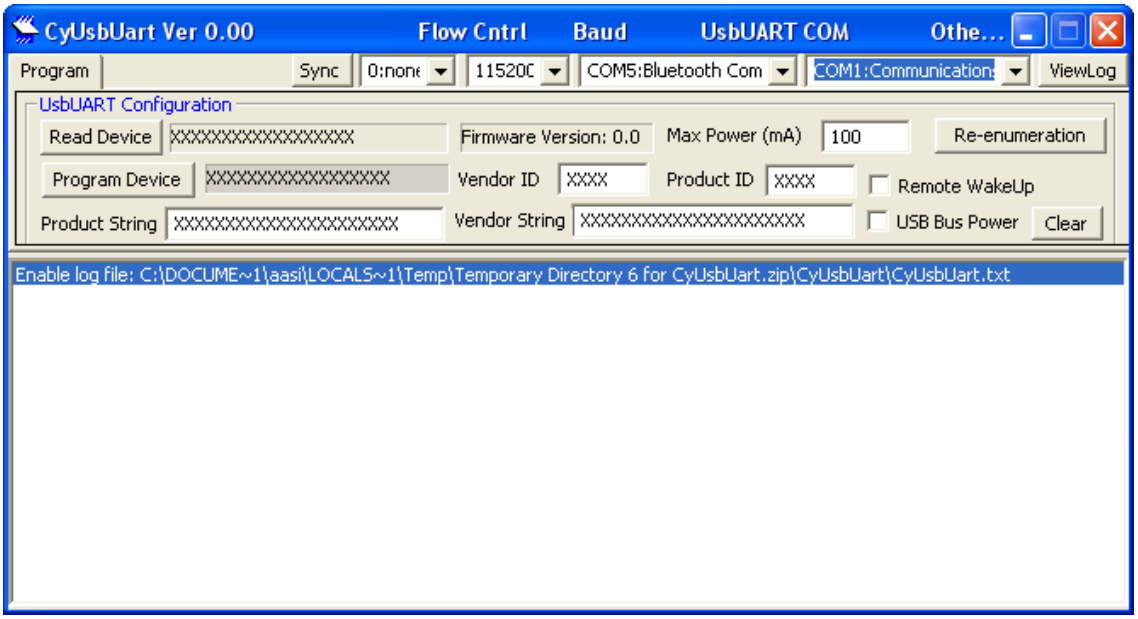
CY7C64225 allows configuration of the following parameters with a configuration utility called CyUSBUART (supplied by Cypress).

- PID and VID
- Manufacturer string descriptor
- Product String descriptor
- Power source (Self/bus)
- Remote Wakeup
- Power consumption

The configuration parameters are stored in the internal EEPROM of CY7C64225 eliminating the need for an external memory component for configuration.

The configuration utility is available for download on Cypress website (http://www.cypress.com/?rID=61047.

Figure 1-11. Screenshot of CyUSBUART



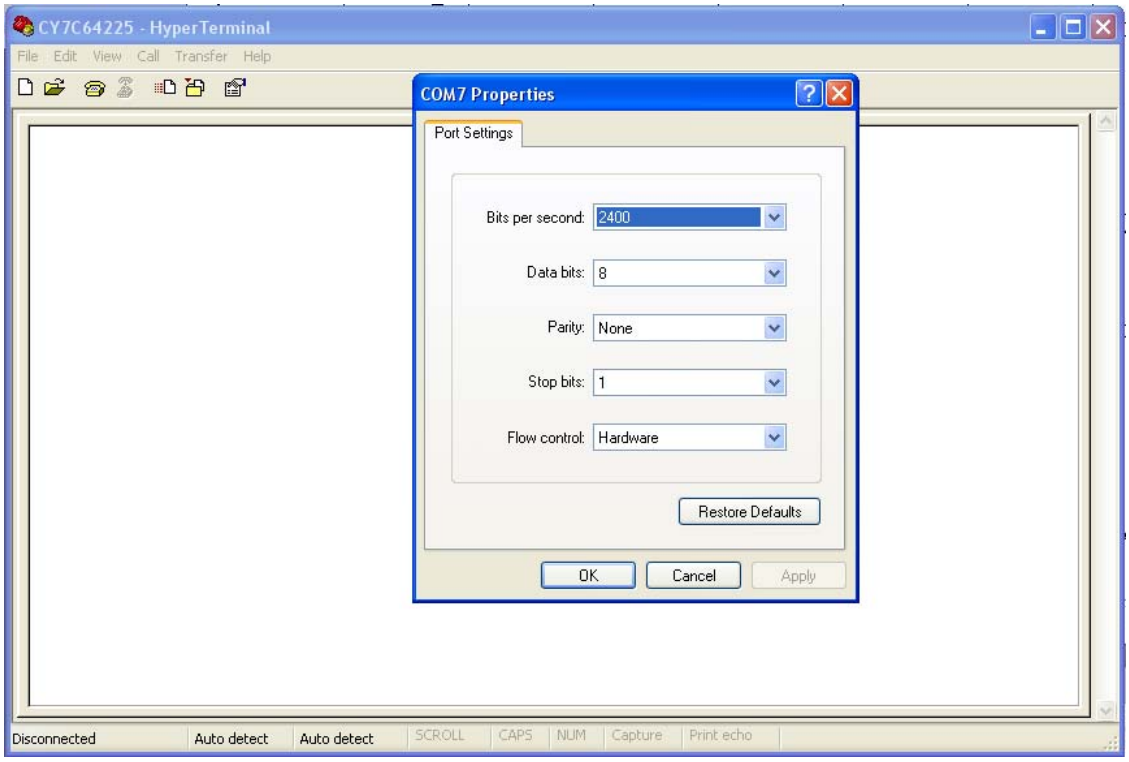
Following is a description of the different options on the utility

- **Read Device** button is used to read the current configuration of the device, programming status and firmware version.
- **Vendor ID** and **Product ID** box allow configuring the VID and PID respectively.
- **Product String** and **Vendor String** box allow configuring the Product Descriptor String and Vendor Descriptor String respectively.
- **Remote WakeUp** checkbox allows enabling/disabling remote wakeup support. Check the box to enable this feature and uncheck to disable it.
- **USB Bus Power** checkbox is used to indicate whether the device will be bus-powered or self-powered. Check the box to configure for bus-powered mode and uncheck for self-powered mode.
- **Max Power (mA)** box is used to specify the maximum current that'll be drawn by the device from the upstream USB supply
- **Program Device** button is used to program the configuration onto the device.

1.5 Baud Rate Configuration

CY7C64225 supports configurable baud rates. Terminal emulator applications like Hyperterminal, Teraterm, and so on to allow selecting the baud rate to be used for communication on the COM port. While opening the Virtual COM port, CDC class request SET_LINE_CODING is sent by the Terminal emulator with the selected baud rate. Based on this request, CY7C64225 configures the baud rate of its UART interface.

Figure 1-12. Selecting Baud Rate while Opening the COM Port using Hyperterminal



1.6 Hardware

CY7C64225 is a fixed function USB to UART Bridge Controller that eliminates the need for any firmware or software development. Hence, the design effort is minimal and only to be spent on the hardware.

1.6.1 Schematic Review Checklist

- CY7C64225 can operate using a single 5 V or 3.3 V supply.
  - 5 V operation reduces BOM cost and also aids in easy integration into designs that rely on upstream USB supply for power (Bus powered application). The voltage specification of this supply pin and that of VBUS (4.75 to 5.25 V) in USB specification are the same.
  - 3.3 V operation aids in easy integration into designs that already have an onboard 3.3 V regulator.
- Decouple the VDD (supply) pin with 1 µF, 0.1 µF, and 0.01 µF in parallel.
- D+ and D- lines are the USB lines. Connect 24 Ω resistors in series with the D+ and D- lines. To reduce BOM cost, CY7C64225 integrates the 1.5 kΩ pull-up resistor on the D+ line needed for full-speed operation.

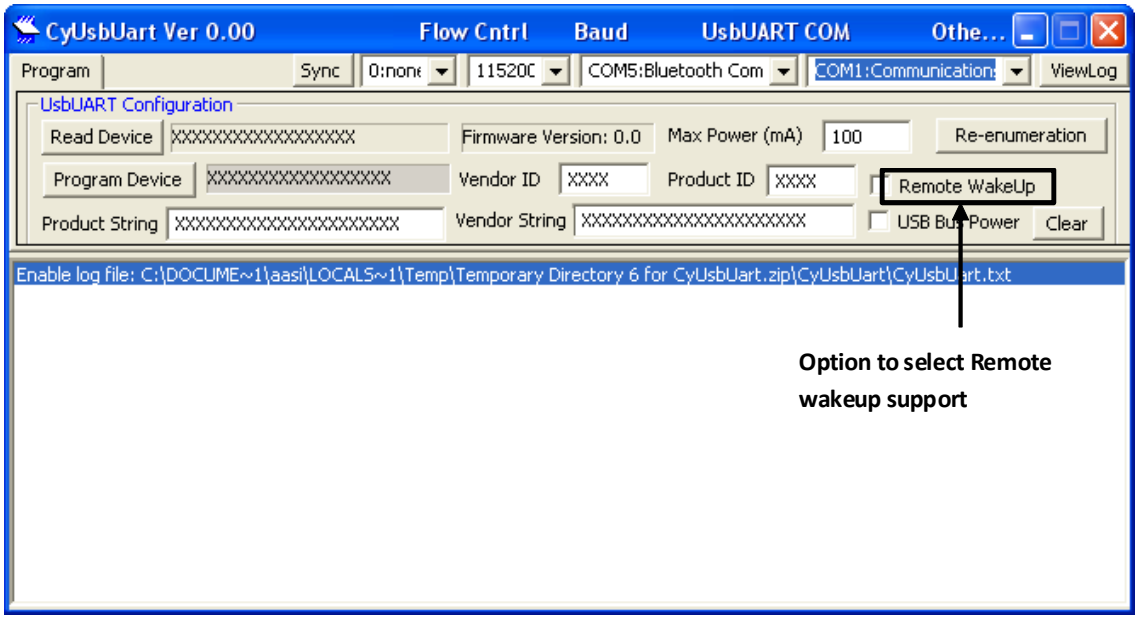
- VBUS pin is used for VBUS (upstream USB supply) monitoring
  - For self-powered devices, connect the VBUS pin to the upstream USB supply pin with a 1 kΩ resistor in series.
  - Bus-powered designs will be powered off when plugged out from the USB port. So for bus-powered designs monitoring the upstream VBUS is not required. Hence connect this pin to logic high (or upstream USB supply) through 1 kΩ resistor. For more details on the science behind VBUS monitoring please refer Monitoring the EZ-USB FX2LP™ VBUS - AN15813.
- Suspend pin is used to indicate whether CY764225 is active or in USB suspend state. An LED can be connected to this pin to provide visual indication of the status.
- VCFG pin is used to indicate whether the USB device is in configured state. A USB device should draw less than 100 mA in an unconfigured state. Designs that draw more than 100 mA can use this pin to keep the other components OFF till the device is configured.
- WAKE pin is used to trigger remote wakeup signaling on the USB bus. Remote wakeup signaling is sent only if the host enables this feature through SET_FEATURE request. Support for remote wakeup is intimated to the host through configuration descriptor. CY7C64225 allows enabling/ disabling this feature through the configuration utility CyUSBUART..
- Tx_LED and Rx_LED are the transmit activity LED and receive activity LED pin respectively. LEDs can be connected to these pins to provide visual indication of data transfer activity on the UART pins and their direction.
- TxD is the UART transmit pin. This pin is connected to the UART receive pin (RX) of the device.
- RxD is the UART receive pin. This pin is connected to the UART transmit pin (TX) of the device.
- Data Terminal Ready (DTR) output pin is used to indicate the status of the UART interface of CY7C64225. Setting this pin active indicates the UART interface is ready. This pin is connected to the Data Set Ready (DSR) pin of the device.
- Data Set Ready (DSR) input pin is used to monitor the status of the device. This pin is connected to the DTR pin of the device.
- RTS output pin is used to indicate the availability of buffer to receive data sent over the UART interface.
  - For devices that don’t support hardware flow control, leave the RTS pin of CY7C64225 floating.
  - For devices that support RTS/CTS hardware flow control connect the RTS pin of CY7C64225 to the CTS pin of the device.
- CTS input pin is used to monitor the RTS pin of the device. If it is driven to logic high, CY7C64225 will not transmit over the UART interface.
  - For devices that don’t support hardware flow control, connect the CTS pin of CY7C64225 to logic Low.
  - For devices that support hardware flow control, but they have the RTS pin driven to logic low, connect the CTS pin of CY7C64225 to RTS pin of the device.
  - For devices that support hardware flow control, connect the CTS pin of CY7C64225 to RTS pin of the device.

1.7 Remote Wakeup

Remote wakeup signaling is used by the USB device to request the host to bring it out of suspend.If acknowledged by the host, the device will resume its normal operation. This is the only device initiated request in USB2.0 specification. bmAttributes field of Configuration descriptor is used to indicate whether the device is capable of remote wakeup signaling. A remote-wakeup capable USB device is allowed to generate this if and only if the host sets this feature through SET_FEATURE request before placing it in suspend. The SET_FEATURE request is sent by the driver without need for user intervention.

CY7C64225 provides the option of configuring support for remote wakeup through the configuration utility. Checking the **Remote WakeUp** checkbox enable remote wakeup support and unchecking disables it. It reflects accordingly in the bmAttributes field of the configuration descriptor. WAKE pin of CY7C64225 is used to generate remote wakeup signaling on the upstream USB. Driving WAKE pin to logic high will generate remote wakeup signaling if and only if CY7C64225 was placed in suspend. If the remote wake-up feature is not set or the device is not in suspend state, then inputs on this pin will be ignored.

Figure 1-13. Configuring Remote Wakeup Support



1.8 Power Management

1.8.1 Introduction

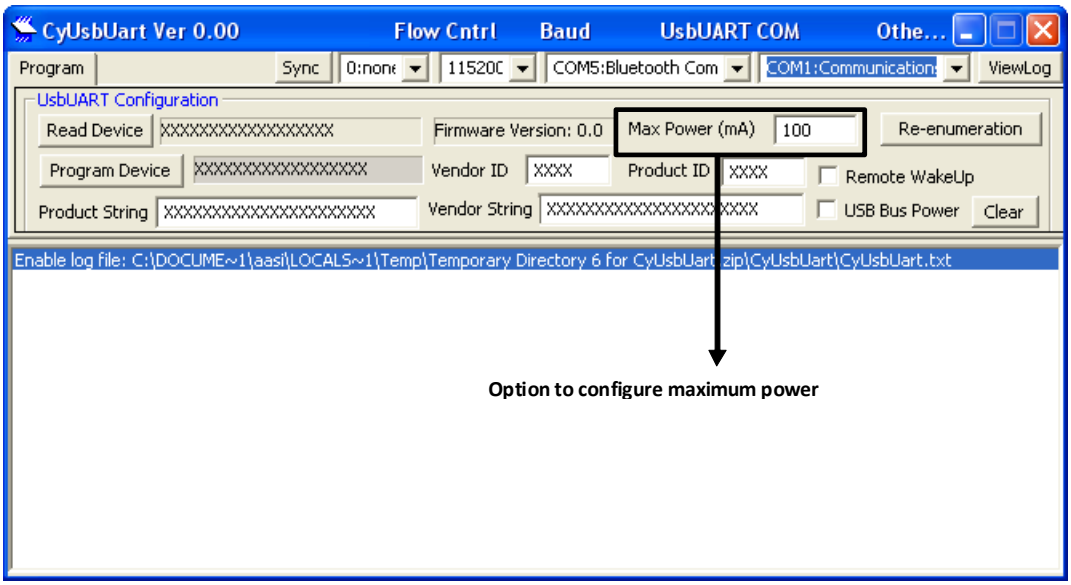
USB specification defines the power that can be drawn by USB devices from the upstream VBUS.USB devices which rely only the upstream VBUS for power are termed bus-powered devices. USB devices that have a secondary power source are termed self-powered devices. Although self-powered devices may be powered before they are connected to USB, they are not considered to be in powered state until they are attached to USB.

A device may support both bus-powered and self-powered configurations. Devices report their power source and maximum power consumption through configuration descriptor. Devices may change their power source at any time i.e. self-powered to bus-powered. Even in this case the device should not exceed the maximum power consumption reported through its configuration descriptor.

1.8.2 Configuring Maximum Power Consumption

CY7C64225 provides the option of configuring the maximum power the device will draw from the upstream VBUS. This value is configured with the **Max Power (mA)** box in the configuration utility and is reflected accordingly in the bMaxPower field of the Device descriptor. By default CY7C64225 is configured for 36 mA.

Figure 1-14. Configuring Power Consumption



1.8.3 Handling USB Device Power States

1.8.3.1 Configured and Unconfigured State

An unconfigured USB device can draw up to 100mA from the upstream VBUS. A Configured device can draw up to the bMaxPower specified in its device descriptor. The device enters configured state when it receives the SET_CONFIGURATION request. The USB host configures the device based on whether it can supply the requested maximum power.

VCFG pin of CY7C64225 is used to meet this requirement. When the device enters configured state this pin will be driven low. Based on the state of this pin, components on the board can be placed in standby/OFF state till the device reaches configured state.

1.8.3.2 *Suspend State*

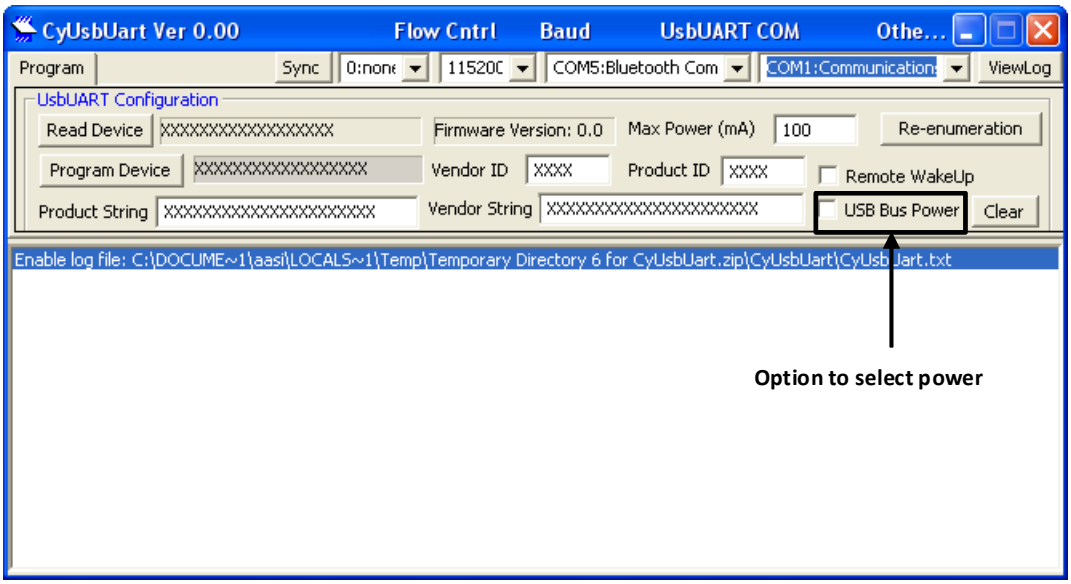
An USB device can draw upto 2.5 mA in suspend state (as per the Engineering Change Notice http://compliance.usb.org/index.asp?UpdateFile=Electrical&Format=Standard#4). When the device enters suspend state this pin will be active low. Based on the state of this pin, components on the board can be placed in standby/OFF state to meet the USB suspend current requirements.

Alternatively an LED can be connected to this pin to provide visual indication of the state of the device. Meeting suspend current requirement with the LED ON is difficult so the LED should be ON when the device is in normal mode and OFF when the device is in suspend state.CY7C64225 resumes normal operation if activity is detected on the USB or the reset pin is asserted.

1.8.4 Configuring Power Source

CY7C64225 can be configured for bus-powered or self-powered operation. This can be configured using the configuration utility and the device will reflect this change accordingly in its configuration descriptor. Checking the **USB Bus Power** checkbox, configures the device for bus-powered operation and unchecking it, configures the device for self-powered operation. By default CY7C64225 is configured for Self-powered operation.

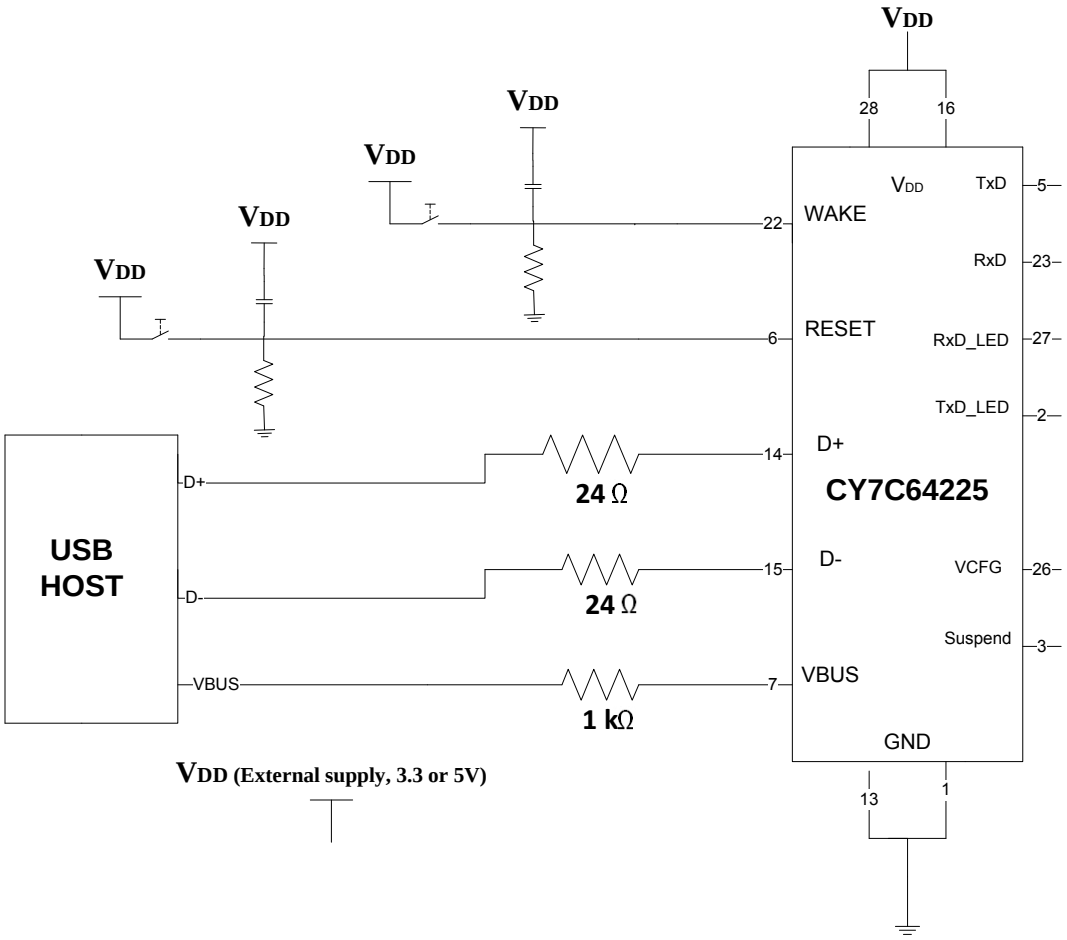
Figure 1-15. Configuring Power Source



1.8.4.1 *Self-powered Configuration*

Self-powered USB device can draw up to 100 mA from upstream VBUS. However, it doesn't have any restriction on the power it can draw from the external supply. **Max Power (mA)** value should be configured accordingly (i.e. should be less than 100 mA). Self-powered configuration is best suited for designs that have a power requirement greater than the maximum current of 500mA that a USB port can provide.

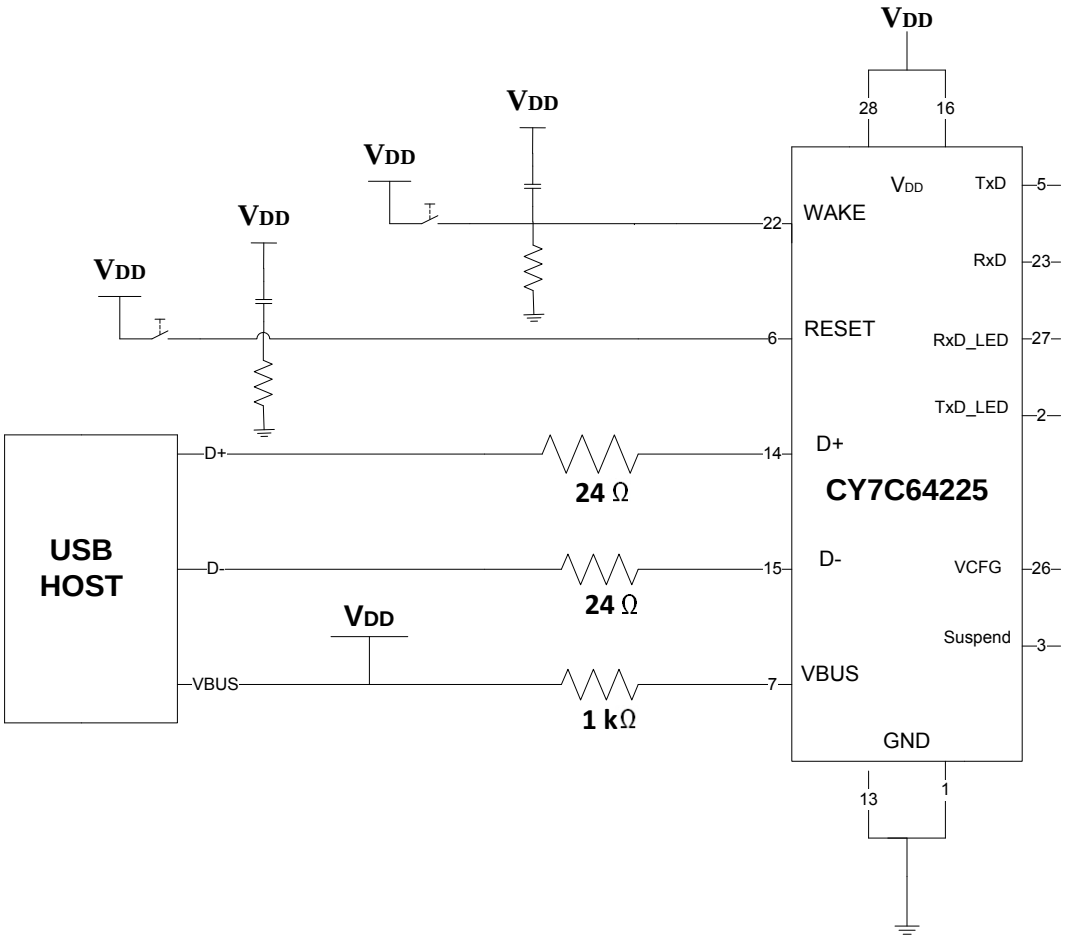
Figure 1-16. Application Circuit Diagram For Self-powered Design



1.8.4.2 *Bus-powered Configuration*

Bus-powered USB device can draw up to 500 mA in configured state, from the upstream VBUS. **Max Power (mA)** value should be configured with the maximum current the design will draw. Bus-powered configuration is best suited for designs that have current requirement less than the maximum current of 500mA that a USB port can provide.

Figure 1-17. Application Circuit Diagram For Bus-powered Design

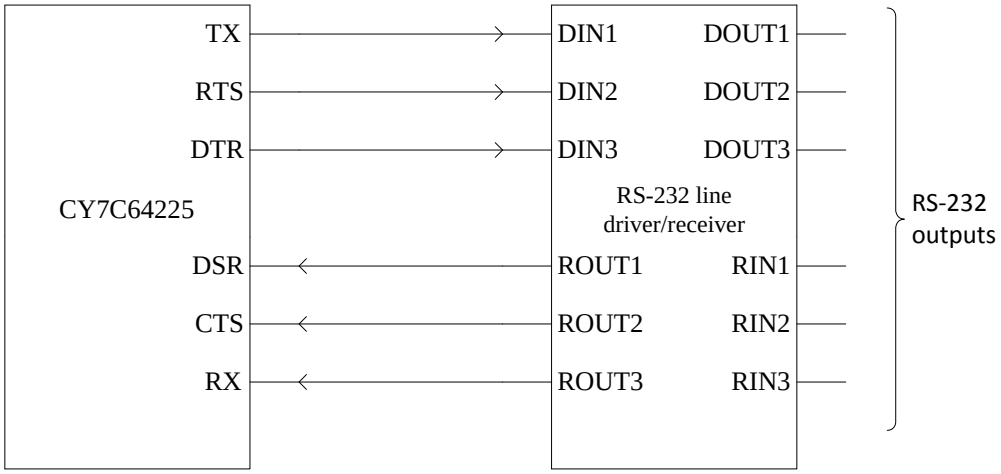


1.9 Interfacing with RS-232 line Drivers/Receivers

RS-232 follows bipolar signaling i.e. the output signal toggles between negative and positive polarity. In RS-232, logic 1 is called Mark and is a -3V input and logic 0 is called Space and is a +3V input. The output voltage level of RS-232 is +/-5V to +/-15V. So there is not only an inversion in polarity but also voltage level translation between the CY7C64225 UART interface and RS-232 signaling. RS-232 line driver/receiver is used for this specific purpose of providing the necessary polarity inversion and level translation.

The connection between CY7C64225 and the RS-232 line driver/receiver is straight-forward and simple. The input lines (DSR, CTS and RX) of the UART interface should be connected to the logic outputs of the RS-232 line driver/receiver chip. The output lines (DTR, RTS and TX) of the UART interface should be connected to the logic inputs of the RS-232 line driver/receiver chip. The inverted, level-translated UART output will be sent through the line driver pins of the RS-232.

Figure 1-18. Application Diagram For Interfacing with RS-232 Line Driver / Receiver



Revision History

Document Revision History

Document Title:CY7C64225 USB to UART Bridge Controller Product Description Guide Document Number: 001-80740				
Revision	**ECN#**	**Issue Date**	**Origin of Change**	**Description of Change**
**	3649008	08/02/2012	AASI\SAVL	New product description guide for CY7C64225.
Distribution: Internal **Posting**: None				