CP2103

SINGLE-CHIP USB TO UART BRIDGE

Single-Chip USB to UART Data Transfer

- Integrated USB transceiver; no external resistors required
- Integrated clock; no external crystal required
- Integrated 1024-Byte EEPROM for vendor ID, product ID, serial number, power descriptor, release number, and product description strings
- On-chip power-on reset circuit
- On-chip voltage regulator: 3.3 V output

USB Function Controller

- USB Specification 2.0 compliant; full-speed (12 Mbps)
- USB suspend states supported via SUSPEND pins

Asynchronous Serial Data BUS (UART)

- All handshaking and modem interface signals
- Data formats supported:
  - Data bits: 5, 6, 7, and 8
  - Stop bits: 1, 1.5, and 2
  - Parity: odd, even, mark, space, no parity
- Baud rates: 300 bps to 1 Mbits
- 576 Byte receive buffer; 640 byte transmit buffer
- Hardware or X-On/X-Off handshaking supported
- Four GPIO signals for status and control
- Configurable I/O (1.8 V to V_{DD}) using V_{IO} pin
- Configurable I/O (V_{DD} to 5 V) using external pull-up
- RS-485 mode with bus transceiver control

Virtual COM Port Device Drivers

- Works with existing COM Port PC applications
- Royalty-free distribution license
- Windows®98 SE/2000/XP
- MAC OS-9
- MAC OS-X
- Linux 2.40

USBXpress™ Direct Driver Support

Example Applications

- Upgrade of RS-232 legacy devices to USB
- Upgrade of RS-485 legacy devices to USB
- Cellular phone USB interface cable
- PDA USB interface cable
- USB to RS-232 serial adapter

Supply Voltage

- Self-powered: 3.0 to 3.6 V
- USB bus powered: 4.0 to 5.25 V
- I/O voltage: 1.8 V to V_{DD}

Package

- Lead free 28-pin QFN (5 x 5 mm)

Ordering Part Number

- CP2103-GM

Temperature Range: –40 to +85 °C

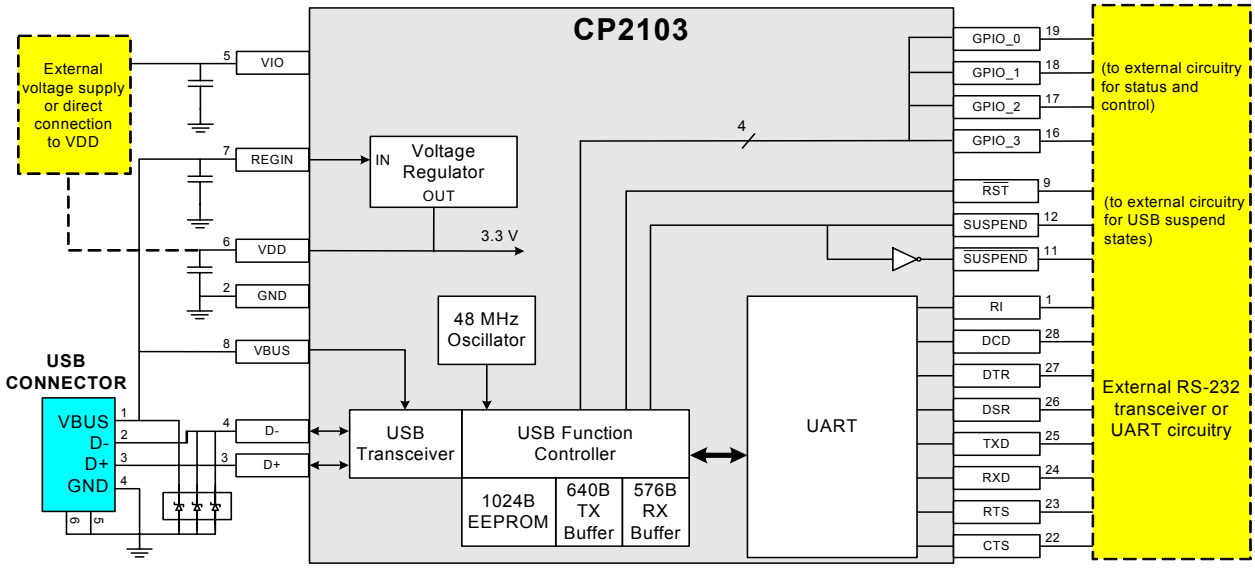

Figure 1. Example System Diagram

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1. System Overview

The CP2103 is a highly-integrated USB-to-UART Bridge Controller providing a simple solution for updating RS-232/RS-485 designs to USB using a minimum of components and PCB space. The CP2103 includes a USB 2.0 full-speed function controller, USB transceiver, oscillator, EEPROM, and asynchronous serial data bus (UART) with full modem control signals in a compact 5 x 5 mm QFN-28 package (sometimes called “MLF” or “MLP”). No other external USB components are required.

The on-chip EEPROM may be used to customize the USB Vendor ID, Product ID, Product Description String, Power Descriptor, Device Release Number, and Device Serial Number as desired for OEM applications. The EEPROM is programmed on-board via the USB allowing the programming step to be easily integrated into the product manufacturing and testing process.

Royalty-free Virtual COM Port (VCP) device drivers provided by Silicon Laboratories allow a CP2103-based product to appear as a COM port to PC applications. The CP2103 UART interface implements all RS-232/RS-485 signals, including control and handshaking signals, so existing system firmware does not need to be modified. The device also features up to (4) GPIO signals that can be user-defined for status and control information. Support for I/O interface voltages down to 1.8 V is provided via a V_{IO} pin. In many existing RS-232 designs, all that is required to update the design from RS-232 to USB is to replace the RS-232 level-translator with the CP2103. See www.silabs.com for the latest application notes and product support information for CP2103.

An evaluation kit for the CP2103 (Part Number: CP2103EK) is available. It includes a CP2103-based USB-to-UART/RS-232 evaluation board, a complete set of VCP device drivers, USB and RS-232 cables, and full documentation. Contact a Silicon Labs’ sales representatives or go to www.silabs.com to order the CP2103 Evaluation Kit.

2. Absolute Maximum Ratings

Table 1. Absolute Maximum Ratings

Parameter	Conditions	Min	Typ	Max	Units
Ambient temperature under bias		–55	—	125	°C
Storage Temperature		–65	—	150	°C
Voltage on any I/O Pin or $\overline{RST}$ with respect to GND		–0.3	—	5.8	V
Voltage on V_{DD} or V_{IO} with respect to GND		–0.3	—	4.2	V
Maximum Total current through V_{DD}, V_{IO}, and GND		—	—	500	mA
Maximum output current sunk by $\overline{RST}$ or any I/O pin		—	—	100	mA

Note: Stresses above those listed may cause permanent damage to the device. This is a stress rating only, and functional operation of the devices at or exceeding the conditions in the operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

3. Global DC Electrical Characteristics

Table 2. Global DC Electrical Characteristics

V_{DD} = 2.7 to 3.6 V, –40 to +85 °C unless otherwise specified.

Parameter	Conditions	Min	Typ	Max	Units
Supply Voltage (V_{DD})		3.0	3.3	3.6	V
Supply Voltage (V_{IO})		1.8	3.3	V_{DD}	V
Supply Current	V_{DD} = 3.3 V	—	26	—	mA
Supply Current in Suspend	V_{DD} = 3.3 V	—	330	—	µA
V_{IO} Supply Current	VBUS = 0 V_{DD} = 0 V_{IO} = 3.0 V	—	500	—	µA
Specified Operating Temperature Range		–40	—	+85	°C

Table 3. UART and Suspend I/O DC Electrical Characteristics

V_{IO} = V_{DD} = 2.7 to 3.6 V, –40 to +85 °C unless otherwise specified.

Parameters	Conditions	Min	Typ	Max	UNITS
Output High Voltage (V_{OH})	I_{OH} = –10 µA I_{OH} = –3 mA I_{OH} = –10 mA	V_{IO} – 0.1 V_{IO} – 0.7 —	— — V_{IO} – 0.8	— — —	V
Output Low Voltage (V_{OL})	I_{OL} = 8.5 mA I_{OL} = 10 µA	— —	— —	0.6 0.1	V
Input High Voltage (V_{IH})		2.0	—	—	V
Input Low Voltage (V_{IL})		—	—	0.8	V
Input Leakage Current	weak pull-ups enabled weak pull-ups disabled	— —	25 —	50 ±1	µA
Maximum Input Voltage	Open drain, logic high (1)	—	—	5.8	V

Table 4. UART and Suspend I/O DC Electrical Characteristics (Low-Voltage Operation)

V_{IO} = 1.8 V to 2.7 V, –40 to +85 °C unless otherwise specified.

Parameters	Conditions	Min	Typ	Max	UNITS
Output High Voltage (V_{OH})	I_{OH} = TBD I_{OH} = TBD I_{OH} = TBD	TBD TBD —	— — TBD	— — —	V
Output Low Voltage (V_{OL})	I_{OL} = TBD I_{OL} = TBD	— —	— —	TBD TBD	V
Input High Voltage (V_{IH})		TBD	—	—	V
Input Low Voltage (V_{IL})		—	—	TBD	V
Input Leakage Current	TBD	—	TBD	TBD	µA
Maximum Input Voltage	Open drain, logic high (1)	—	—	TBD	V

4. Pinout and Package Definitions

Table 5. CP2103 Pin Definitions

Name	Pin #	Type	Description
V_{DD}	6	Power In Power Out	3.0–3.6 V Power Supply Voltage Input. 3.3 V Voltage Regulator Output. See Section 11.
V_{IO}	5	Power In	1.8 V to V_{DD} I/O Supply Voltage Input.
GND	2		Ground. Must be tied to ground.
SGND			Ground. Must be tied to ground.
$\overline{RST}$	9	D I/O	Device Reset. Open-drain output of internal POR or V_{DD} monitor. An external source can initiate a system reset by driving this pin low for at least 15 µs.
REGIN	7	Power In	5 V Regulator Input. This pin is the input to the on-chip voltage regulator.
VBUS	8	D In	VBUS Sense Input. This pin should be connected to the VBUS signal of a USB network. A 5 V signal on this pin indicates a USB network connection.
D+	3	D I/O	USB D+
D–	4	D I/O	USB D–
TXD	25	D Out	Asynchronous data output (UART Transmit)
RXD	24	D In	Asynchronous data input (UART Receive)
CTS	22*	D In	Clear To Send control input (active low)
RTS	23*	D Out	Ready to Send control output (active low)
DSR	26*	D in	Data Set Ready control input (active low)
DTR	27*	D Out	Data Terminal Ready control output (active low)
DCD	28*	D In	Data Carrier Detect control input (active low)
RI	1*	D In	Ring Indicator control input (active low)
SUSPEND	12*	D Out	This pin is driven high when the CP2103 enters the USB suspend state.
$\overline{SUSPEND}$	11*	D Out	This pin is driven low when the CP2103 enters the USB suspend state.
NC	10, 13–15, 20–21		These pins should be left unconnected or tied to V_{DD}.
GPIO.3	16	D I/O	User-configurable input or output.
GPIO.2	17	D I/O	User-configurable input or output.
GPIO.1	18	D I/O	User-configurable input or output.
GPIO.0	19	D I/O	User-configurable input or output.
***Note:** Pins can be left unconnected when not used.			

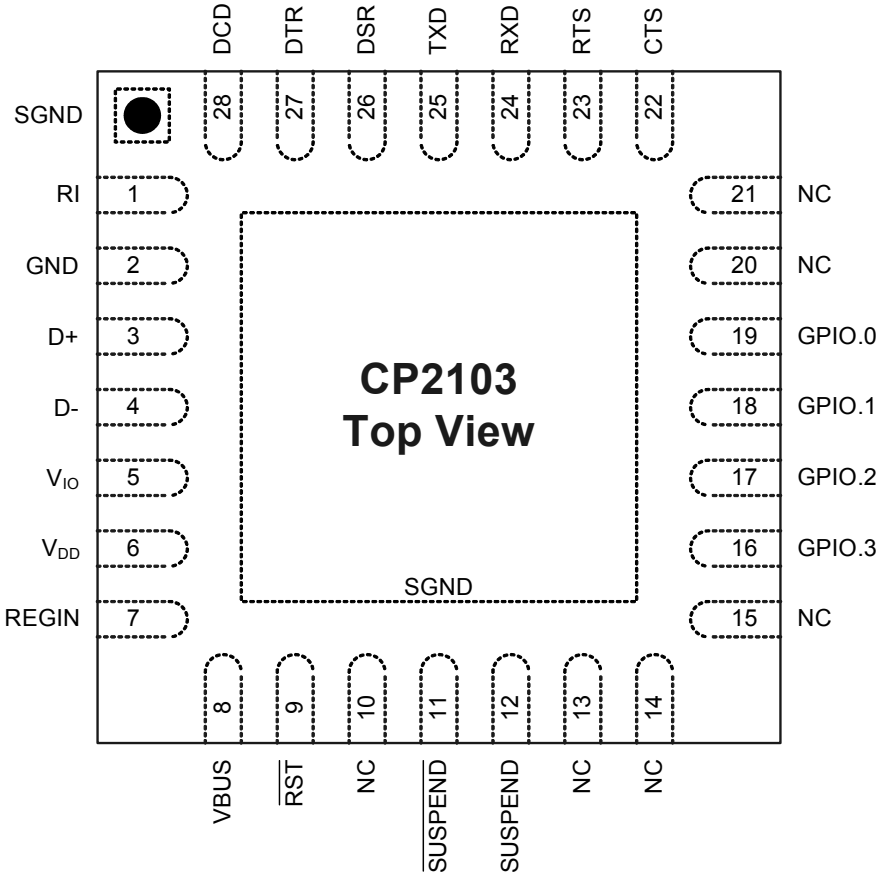


Figure 2. QFN-28 Pinout Diagram (Top View)

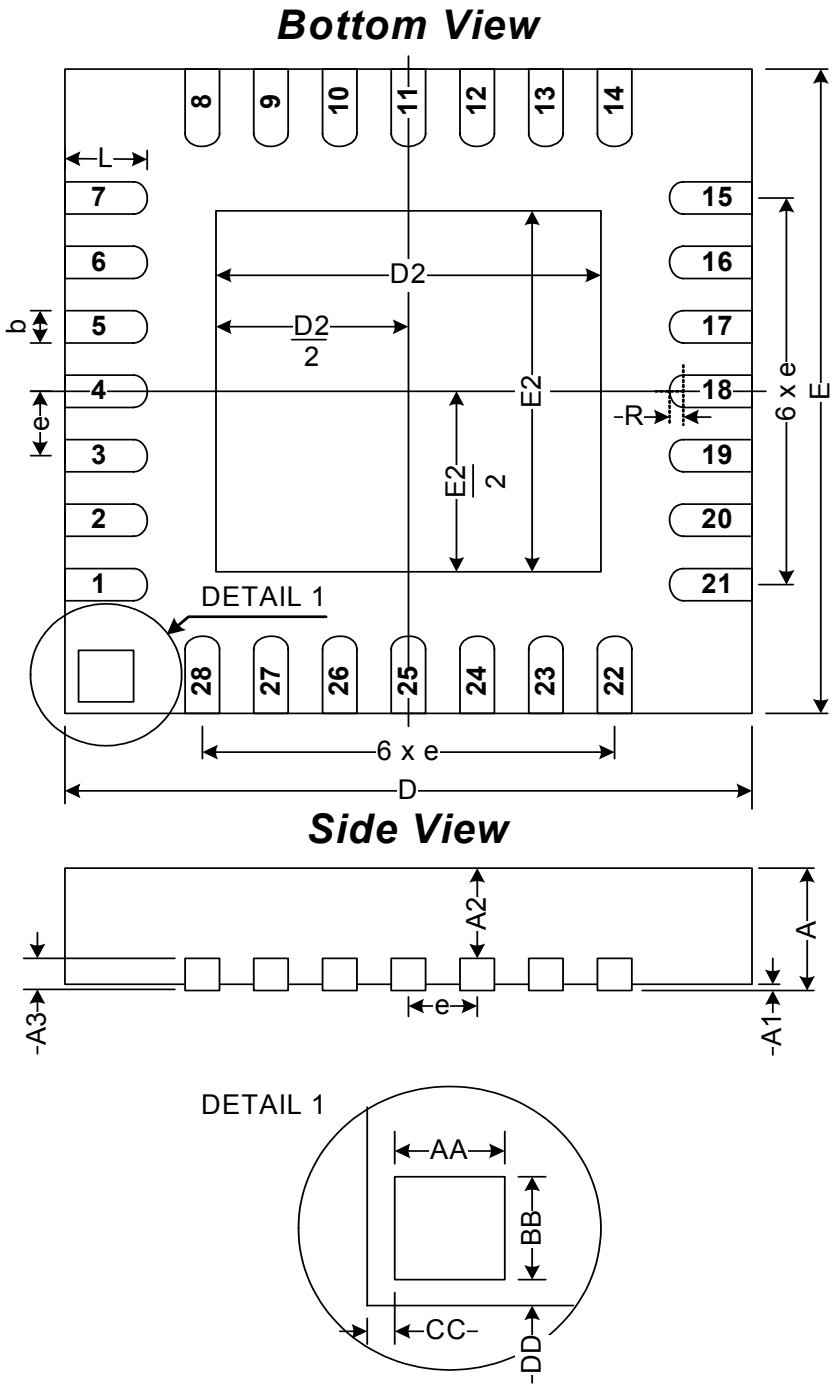


Table 6. QFN-28 Package Dimensions

	MM		
	MIN	TYP	MAX
A	0.80	0.90	1.00
A1	0	0.02	0.05
A2	0	0.65	1.00
A3	—	0.25	—
b	0.18	0.23	0.30
D	—	5.00	—
D2	2.90	3.15	3.35
E	—	5.00	—
E2	2.90	3.15	3.35
e	—	0.5	—
L	0.45	0.55	0.65
N	—	28	—
ND	—	7	—
NE	—	7	—
R	0.09	—	—
AA	—	0.435	—
BB	—	0.435	—
CC	—	0.18	—
DD	—	0.18	—

Figure 3. QFN-28 Package Drawing

Top View

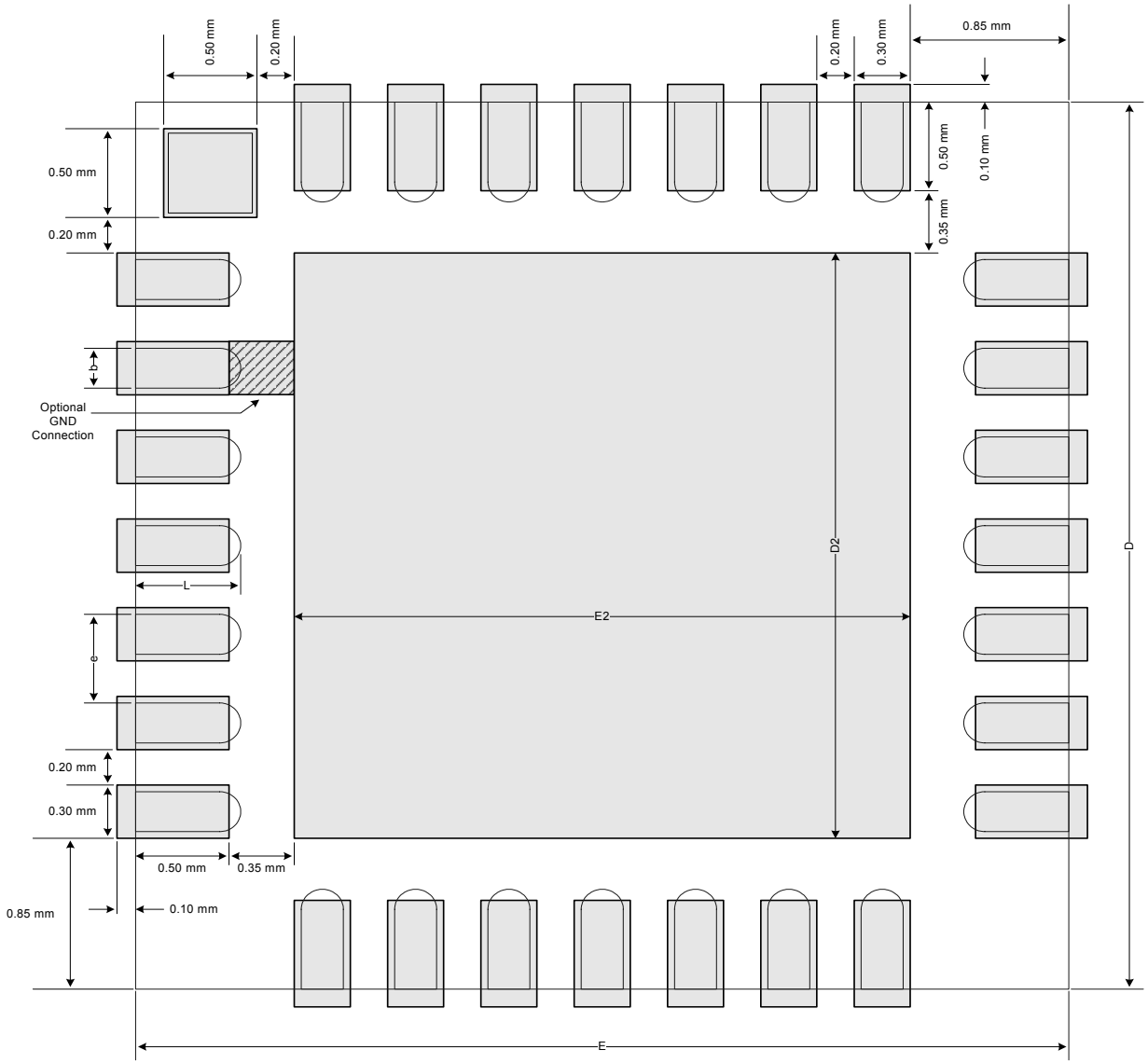


Figure 4. Typical QFN-28 Landing Diagram

Top View

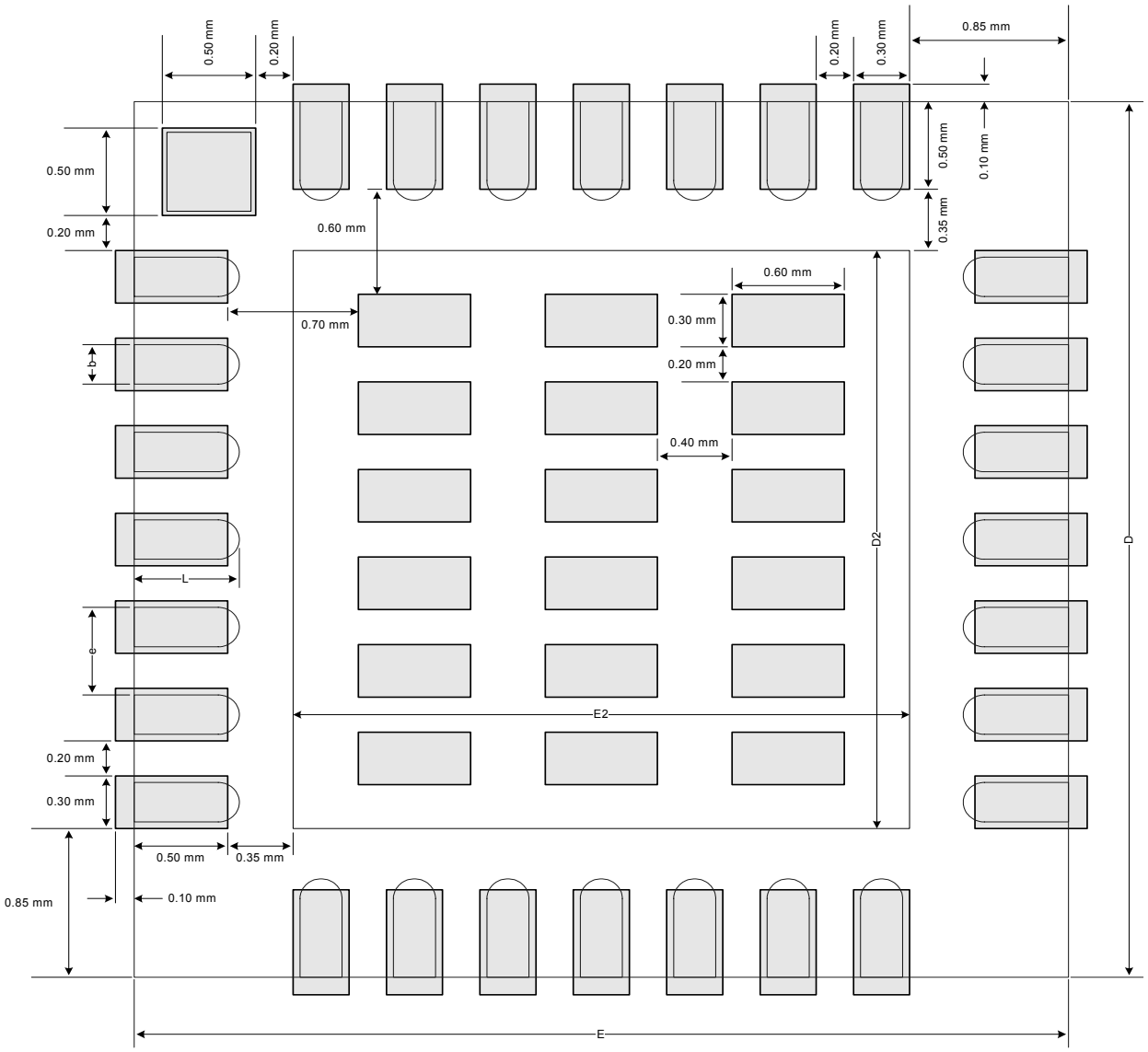


Figure 5. Typical QFN-28 Solder Paste Diagram

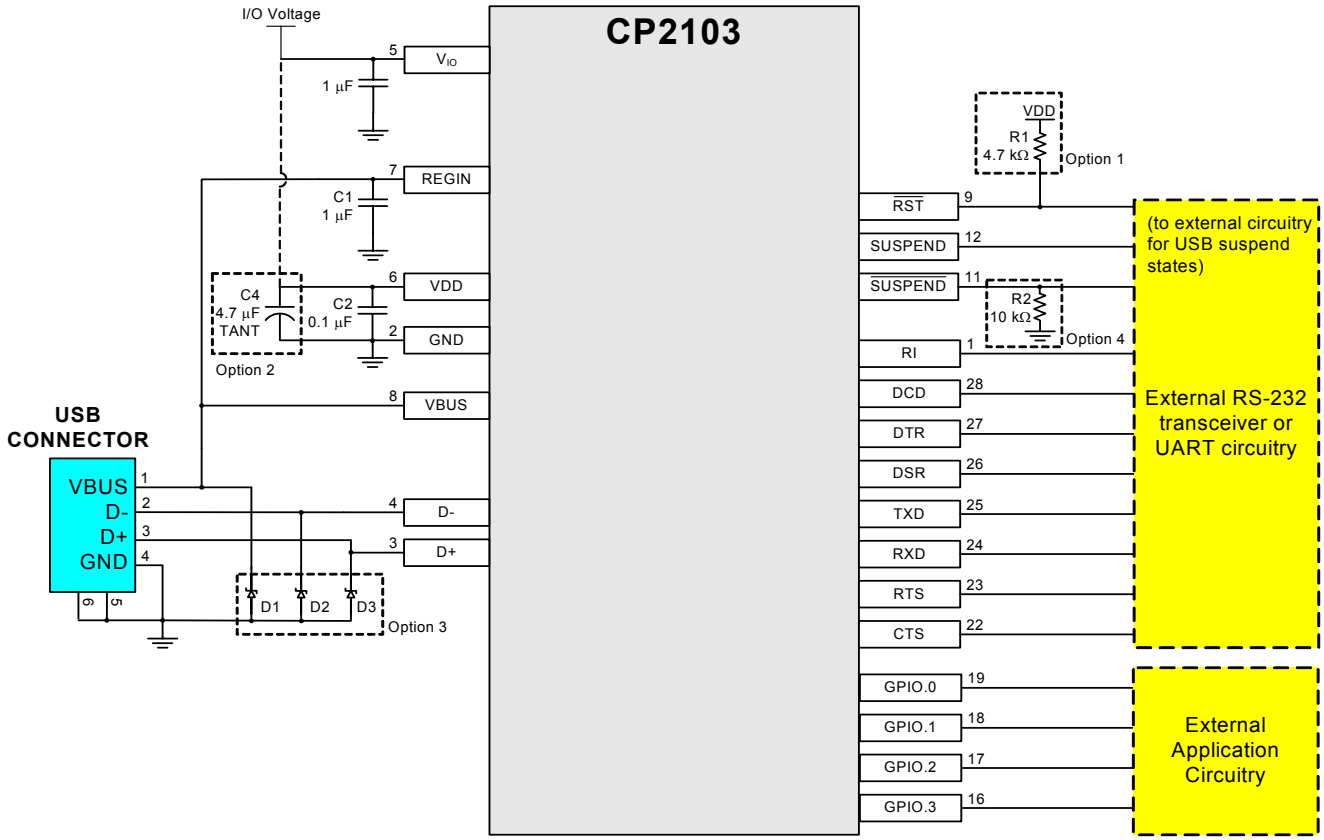
5. USB Function Controller and Transceiver

The Universal Serial Bus function controller in the CP2103 is a USB 2.0 compliant full-speed device with integrated transceiver and on-chip matching and pull-up resistors. The USB function controller manages all data transfers between the USB and the UART as well as command requests generated by the USB host controller and commands for controlling the function of the UART.

The USB Suspend and Resume signals are supported for power management of both the CP2103 device as well as external circuitry. The CP2103 will enter Suspend mode when Suspend signaling is detected on the bus. On entering Suspend mode, the CP2103 asserts the SUSPEND and $\overline{\text{SUSPEND}}$ signals. SUSPEND and $\overline{\text{SUSPEND}}$ are also asserted after a CP2103 reset until device configuration during USB Enumeration is complete.

The CP2103 exits the Suspend mode when any of the following occur: (1) Resume signaling is detected or generated, (2) a USB Reset signal is detected, or (3) a device reset occurs. On exit of Suspend mode, the SUSPEND and $\overline{\text{SUSPEND}}$ signals are de-asserted.

Both SUSPEND and $\overline{\text{SUSPEND}}$ temporarily float high during a CP2103 reset. If this behavior is undesirable, a strong pulldown (10 kΩ) can be used to ensure $\overline{\text{SUSPEND}}$ remains low during reset. See Figure 6 for other recommended options.



Option 1: A 4.7 kΩ pull-up resistor can be added to increase noise immunity.
Option 2: A 4.7 µF tantalum capacitor can be added if powering other devices from the on-chip regulator.
Option 3: Avalanche transient voltage suppression diodes should be added for ESD protection. Use Littlefuse p/n SP0503BAHT or equivalent.
Option 4: 10 kΩ resistor to ground to hold $\overline{\text{SUSPEND}}$ low on initial power on or device reset.

Figure 6. Typical Connection Diagram

6. Asynchronous Serial Data Bus (UART) Interface

The CP2103 UART interface consists of the TX (transmit) and RX (receive) data signals as well as the RTS, CTS, DSR, DTR, DCD, and RI control signals. The UART supports RTS/CTS, DSR/DTR, and X-On/X-Off handshaking.

The UART is programmable to support a variety of data formats and baud rates. The data format and baud rate programmed into the UART is set during COM port configuration on the PC. The data formats and baud rates available are listed in Table 7.

Table 7. Data Formats and Baud Rates

Data Bits	5, 6, 7, and 8
Stop Bits	1, 1.5[1], and 2
Parity Type	None, Even, Odd, Mark, Space
Baud Rates[2]	300, 600, 1200, 1800, 2400, 4000, 4800, 7200, 9600, 14400, 16000, 19200, 28800, 38400, 51200, 56000, 57600, 64000, 76800, 115200, 128000, 153600, 230400, 250000, 256000, 460800, 500000, 576000, 921600[3]

Notes:
1. 5-bit only.
2. Additional baud rates are supported. See “AN205: CP210x Baud Rate Support”.
3. 7 or 8 data bits only.

7. GPIO Pins

The CP2103 supports (4) user-configurable GPIO pins for status and control information. More information regarding the configuration and usage of these pins can be found in “AN144: CP210x Customization Guide” and “AN223: Port Configuration and GPIO for CP210x” available on the Silicon Laboratories website.

8. Internal EEPROM

The CP2103 includes an internal EEPROM that may be used to customize the USB Vendor ID, Product ID, Product Description String, Power Descriptor, Device Release Number, and Device Serial Number as desired for OEM applications. Customization of the USB configuration data is optional. If the EEPROM is not programmed with OEM data, the default configuration data shown in Table 8 is used. However, a unique serial number is required for OEM applications in which it is possible for multiple CP2103-based devices to be connected to the same PC.

The internal EEPROM is programmed via the USB. This allows the OEM's USB configuration data and serial number to be written to the CP2103 on-board during the manufacturing and testing process. A stand-alone utility for programming the internal EEPROM is available from Silicon Laboratories. A library of routines provided in the form of a Windows® DLL is also available. This library can be used to integrate the EEPROM programming step into custom software used by the OEM to streamline testing and serial number management during manufacturing. The EEPROM has a typical endurance of 100,000 write cycles with a data retention of 100 years.

USB descriptors can be locked to prevent future modification.

Table 8. Default USB Configuration Data

Name	Value
Vendor ID	10C4h
Product ID	EA60h
Power Descriptor (Attributes)	80h
Power Descriptor (Max. Power)	32h
Release Number	0100h
Serial Number	0001 (63 characters maximum)
Product Description String	“CP2103 USB to UART Bridge Controller” (126 characters maximum)

9. Virtual Com Port Device Drivers

The CP210x Virtual COM Port (VCP) device drivers allow a CP2103-based device to appear to the PC's application software as an additional COM port (in addition to any existing hardware COM ports). Application software running on the PC accesses the CP2103-based device as it would access a standard hardware COM port. However, actual data transfer between the PC and the CP2103 device is performed over the USB. Therefore, existing COM port applications may be used to transfer data via the USB to the CP2103-based device without modifying the application. Contact Silicon Laboratories for the latest list of supported operating systems.

Note: Silicon Laboratories’ VCP device drivers are required for device operation and are only distributed as part of the CP2103 Evaluation Kit (Part Number: CP2103EK). Contact any of Silicon Lab’s sales representatives or go to www.silabs.com to order the CP2103 Evaluation Kit. The CP210x drivers and programming utilities are subject to change without notice. Subscription to the website "Auto Email Alert" system for automatic notification of updates and the use of the "Product Update Registration" service is recommended.

10. USBXpress™ Direct Driver Support

The Silicon Laboratories USBXpress™ for CP210x Development Kit provides an alternate solution for interfacing with CP2103 devices than using the Virtual COM port. No Serial Port protocol expertise is required. Instead, a simple, high-level application program interface (API) is used to provide simpler CP2103 connectivity and functionality.

The USBXpress for CP210x Development Kit includes Windows device drivers, Windows device driver installer and uninstallers, and a host interface function library (host API) provided in the form of a Windows Dynamic Link Library (DLL). The included device drivers and installation files support MS Windows 98SE/2000/XP.

11. Voltage Regulator

The CP2103 includes an on-chip 5 to 3 V voltage regulator. This allows the CP2103 to be configured as either a USB bus-powered device or a USB self-powered device. These configurations are shown in Figure 7 and Figure 8. When enabled, the 3 V voltage regulator output appears on the V_{DD} pin and can be used to power external 3 V devices. See Table 9 for the voltage regulator electrical characteristics.

Alternatively, if 3 V power is supplied to the V_{DD} pin, the CP2103 can function as a USB self-powered device with the voltage regulator disabled. For this configuration, it is recommended that the REGIN input be tied to the 3 V net to disable the voltage regulator. This configuration is shown in Figure 9.

The USB max power and power attributes descriptor must match the device power usage and configuration. See application note “AN144: CP210x Customization Guide” for information on how to customize USB descriptors for the CP2103.

Note: It is recommended that additional decoupling capacitance (e.g., 0.1 µF in parallel with 1.0 µF) be provided on the REGIN input.

Table 9. Voltage Regulator Electrical Specifications

–40 to +85 °C unless otherwise specified.

Parameter	Conditions	Min	Typ	Max	Units
Input Voltage Range		4.0	—	5.25	V
Output Voltage	Output Current = 1 to 100 mA*	3.0	3.3	3.6	V
VBUS Detection Input Threshold		1.0	1.8	4.0	V
Bias Current		—	110	—	µA
***Note:** The maximum regulator supply current is 100 mA.					

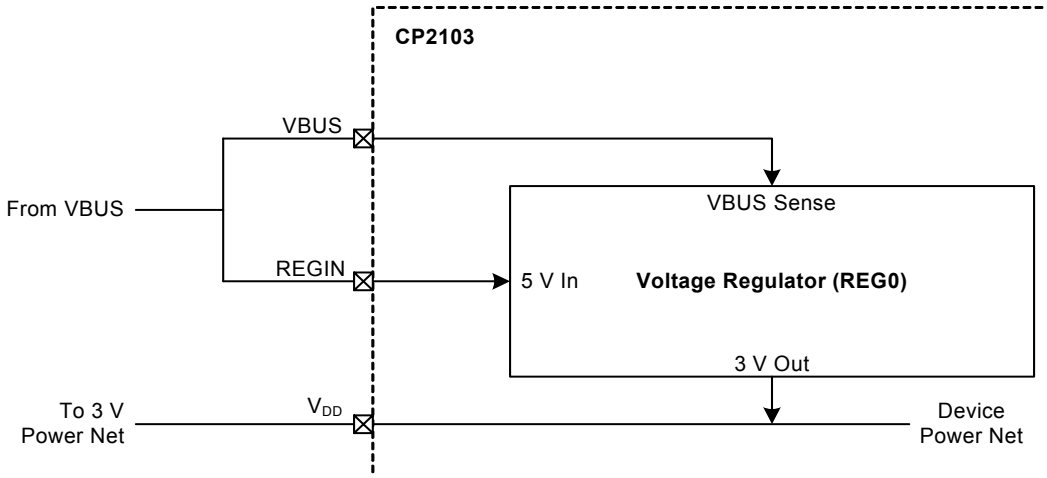


Figure 7. Configuration 1: USB Bus-Powered

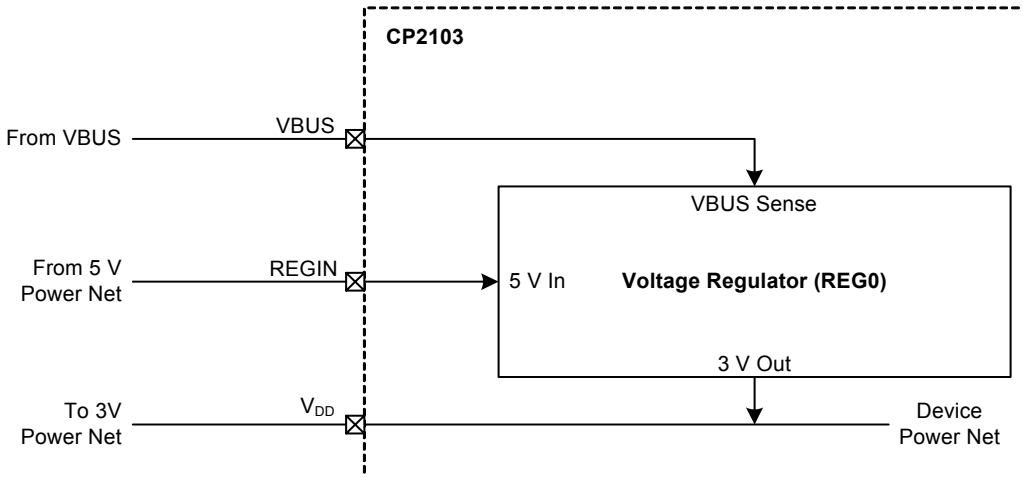


Figure 8. Configuration 2: USB Self-Powered

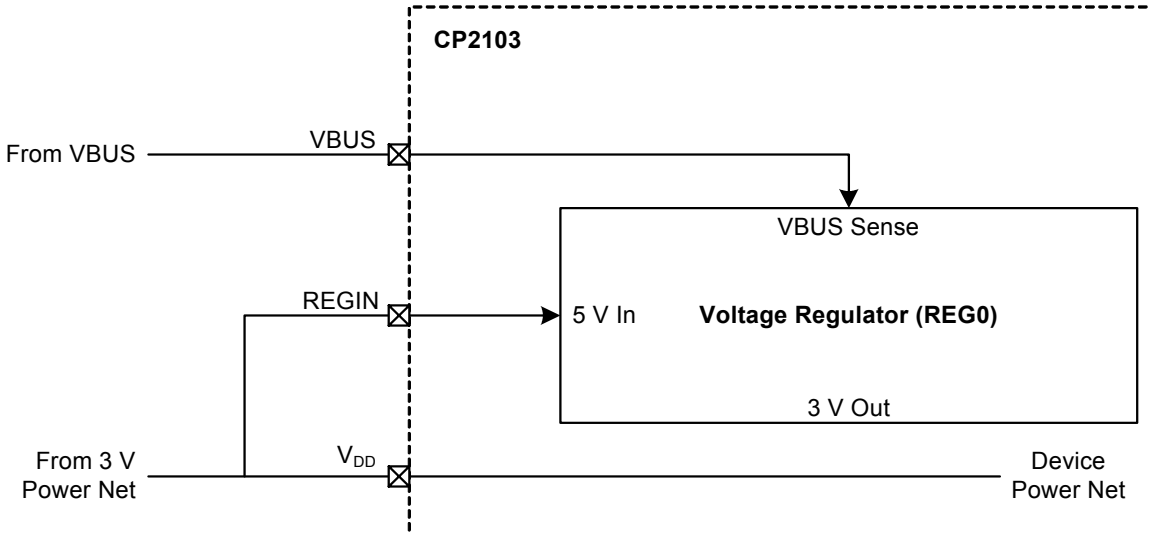


Figure 9. Configuration 3: USB Self-Powered, Regulator Bypassed

Document Change List

Revision 0.1 to Revision 0.2

- Updated “Linux 2.40” bullet on page 1.

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