8-bit Universal Asynchronous Receiver Transmitter

Example Name: Example_UART
Programming Language: C
Associated Part Families: CY8C29/27/24/22/21xxx, CY8C23x33, CY7C64215, CYWUSB6953, CY8CNP102, CY8CLED02/04/08/16, CY8CLED03D/04D, CY8CTST110, CY8CTMG110, CY8CTST120 CY8CTMG120, CY8CTMA120, CY8C21x45,CY8C22x45, CY8CTMG300, CY8CTST300, CY8CTMA300 CY8CTMA301, CY8CTMA301D, CY8C28x45,CY8CPLC20, CY8CLED16P01, CY8C28x43, CY8C28x52
Software Version: PSoC® Designer™ 5.1 SP2
Related Hardware: CY3210 PSoCEval1

Objective

The operation of the 8-bit universal asynchronous receiver transmitter (UART) user module in PSoC® is demonstrated in this example.

Overview

A command and some parameters (separated by spaces) are transmitted to the PSoC by a personal computer using Windows Hyper Terminal, through the serial port. The data is received and decoded by PSoC and the command and parameters are echoed back to the PC (line by line).

User Module List and Placement

The following table lists the hardware resources occupied by the user module.

User Module	Placement
UART	DCB02 (TX Configuration) DCB03 (RX Configuration)

User Module Parameter Settings

The following table lists the UART user module parameter settings.

UART		
Parameter	**Value**	**Comments**
Clock	VC3	Input is 153.8 KHz clock (eight times baud rate - 19200). VC3 = Sys.Clk / 156
RX Input	Row_0_Input_1	Routed from pin P2[5] through GlobalInEven_5
TX Output	Row_0_Output_3	Routed to pin P2[7] through GlobalOutEven_7
TX InterruptMode	TXRegEmpty	Not used
Clock Sync	Sync to Sys.Clock	Clock is synchronized with the SysClk, as VC3 is a derivative of SysClk
RxCmdBuffer	Enable	Enables Command buffer, and stores the received command in a RAM buffer
RxBufferSize	32	Bytes length of buffer is 32 characters (including parameters)
Command Terminator	13	Carriage return (13) is the command terminator
Param_Delimiter	32	Space (32) is the parameter delimiter
IgnoreCharsBelow	32	Ignore control characters that have ASCII value below 32
Enable Backspace	Disable	Not used
Rx Output	None	Not used
Rx Clock Out	None	Not used
Tx Clock Out	None	Not used

UART		
Parameter	**Value**	**Comments**
InvertRX Input	Normal	Do not invert Rx Input

Note The clock to the TX8 user module should be eight times the desired baud rate. The parameters Command Terminator, ParamDelimiter, and IgoneCharsBelow are used by the high level UART API to process the commands received. When the UART receives the character set as Command Terminator, the API reports through a flag that a valid command has been received. When the character set as ParamDelimiter is encountered, the API understands that the characters that follow the ParamDelimiter are the next parameter in the command. The API ignores any characters below the value set in IgonreCharsBelow value and does not store them in the command buffer.

Global Resources

Important Global Resources		
Parameter	**Value**	**Comments**
CPU_Clock	SysClk/2	Sets the CPU frequency to 12 MHz
VC3 Source	SysClk/1	Set System Clock as the source for VC3
VC3 Divider	156	Divide 24 MHz system clock by 156 (effective baud rate is 19.2 kbps)

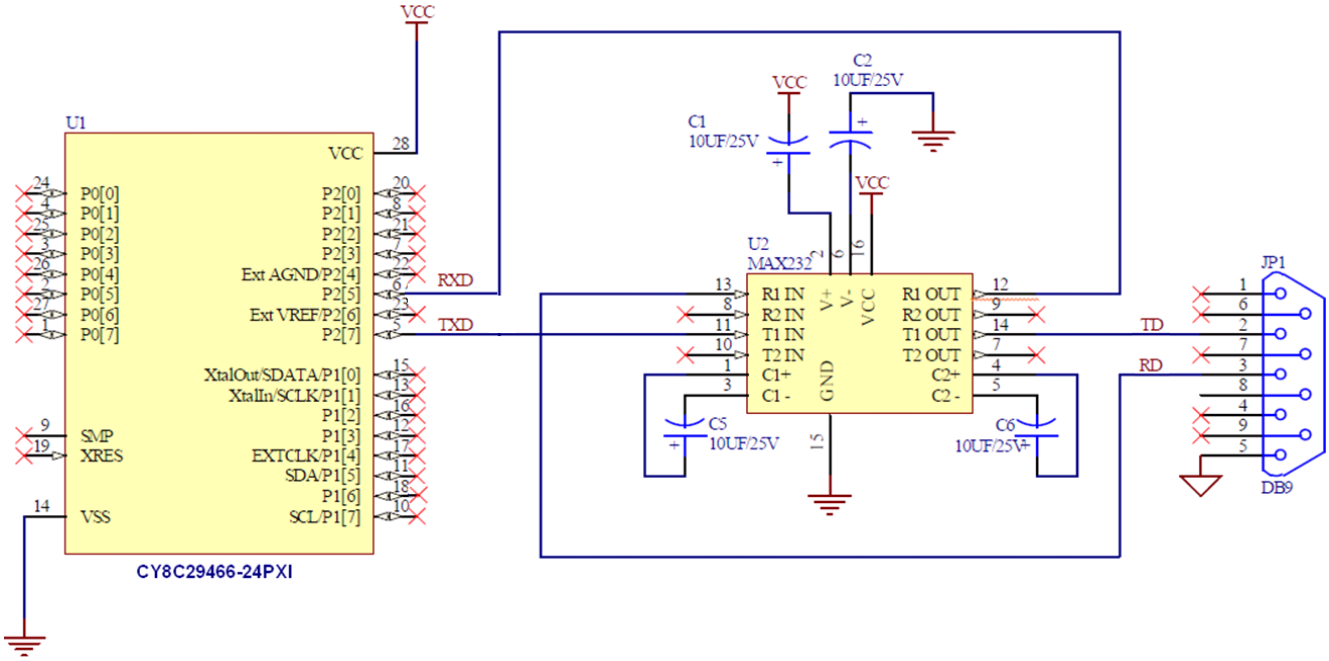
Note Leave all other global resources at their default.

Pin Configuration

Pin	Select	Drive	Interrupt
P2 [7]	GlobalOutEven_7	Strong	DisableInt
P2 [5]	GlobalInEven_5	High Z	DisableInt

Hardware Connections

Figure 1.Schematic Diagram



MAX232, a RS232 transceiver, is used to translate the ±10 V RS232 signals to transistor-transistor logic (TTL) level signals of the PSoC.

JP1 is a 9 pin female serial port connector is used to connect the project with a PC.

The code can be tested using CY3210 – PSoC Eval1 board. This board has a RS232 transceiver and a serial port connector. To test the code using the CY3210 board, make the following connections:

- Connect P25 of J7 to RX of J13
- Connect P27 of J7 to TX of J13

Operation

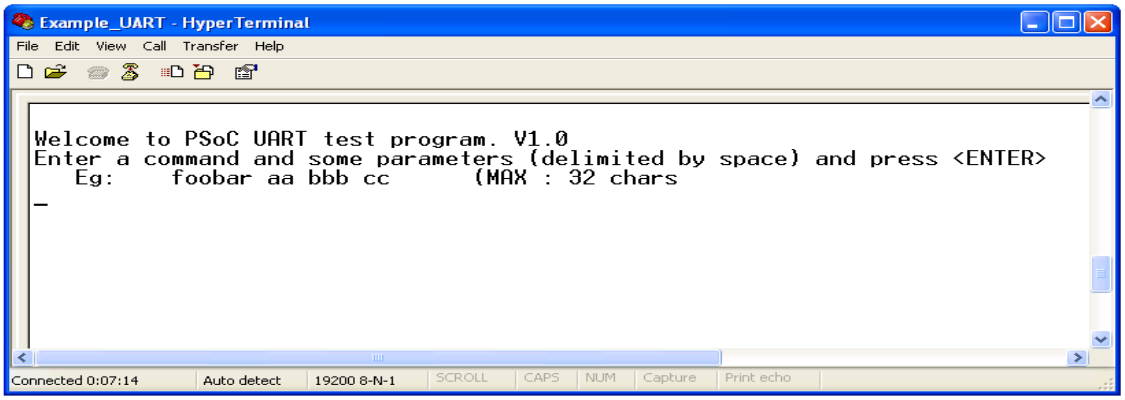
All hardware settings from the device configuration are loaded into the device and *main.c* is executed on program execution.

The 24-MHz system clock is divided by 156 (VC3) to produce a 153.8-KHz clock, which is provided to the UART user module. The transfer rate is 1/8 times the clock, that is, 19.2 kbps. Parity is set to none in the initial configuration for the block and may also be set using the UART APIs.

After setting up the **HyperTerminal** as explained in the section "Testing the Project" on page 5, click **Call** menu in the **HyperTerminal** and reset the PSoC.

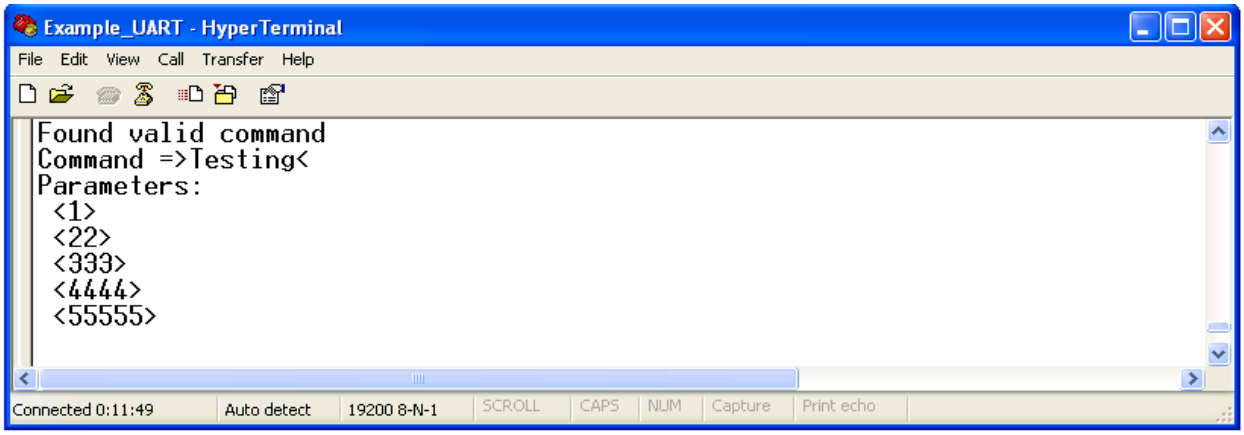
The **HyperTerminal** window displays the following message.

Figure 2.Welcome Screen on HyperTerminal



PSoC decodes the command and parameters according to the commands typed on the HyperTerminal. For example, when a string "Testing 1 22 333 4444 55555" is entered in hyper terminal, PSoC responds as shown in the following figure.

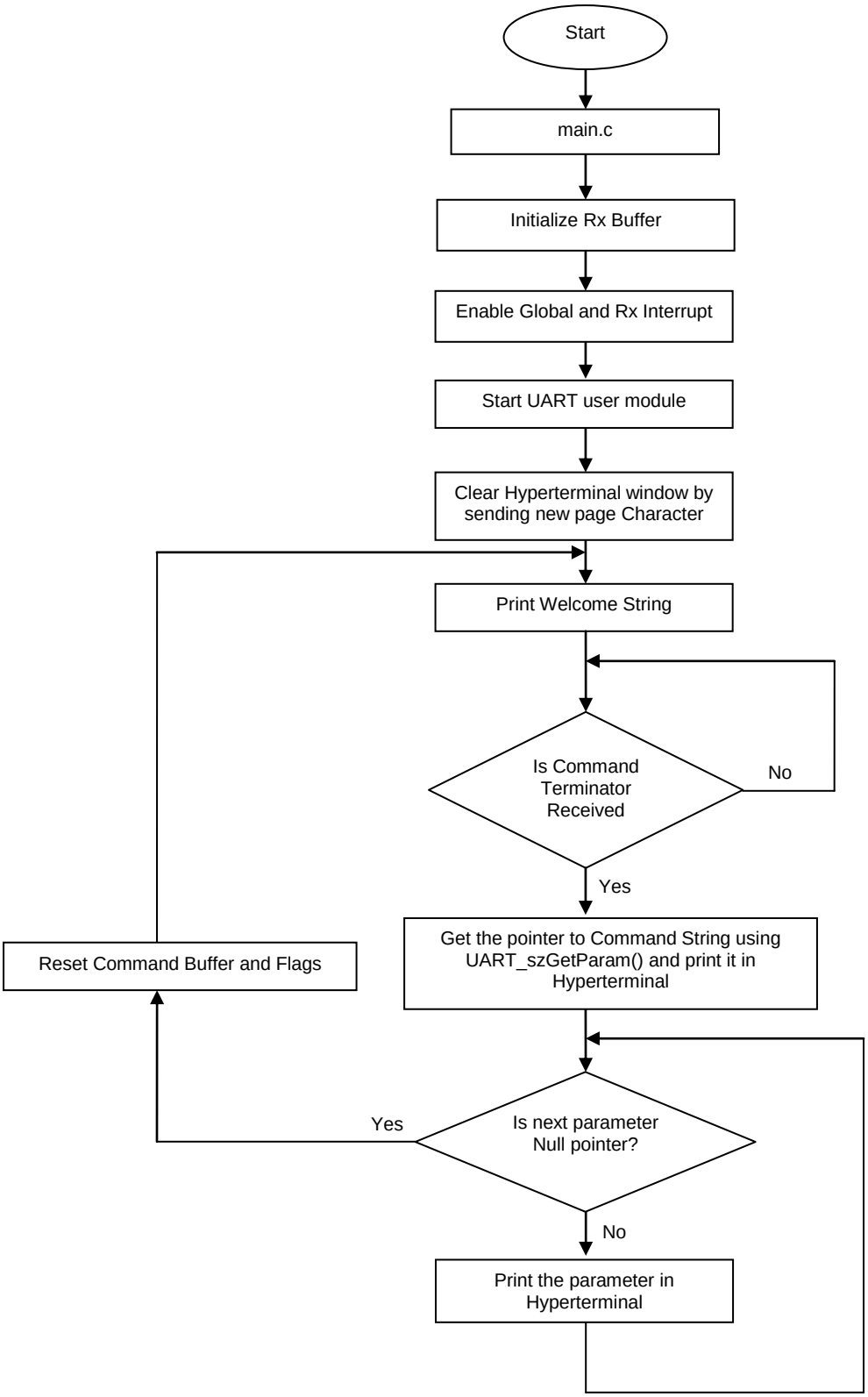
Figure 3.PSoC Response in HyperTerminal



Note For more information on user modules, see the specific user module datasheet included in the PSoC Designer™.

The flowchart of the program execution is shown as follows.

Figure 4.Program Execution Flowchart



Testing the Project

Use **HyperTerminal** (or any other terminal program) to test the project. Configure **HyperTerminal** as follows in Windows.

1. Connect the CY3210 board to the PC serial port using a serial port cable.
2. Start **HyperTerminal** using **Start → All Programs → Accessories → Communication → HyperTerminal**
3. Enter a Name for the connection, for example **Example_UART** and click **OK**.

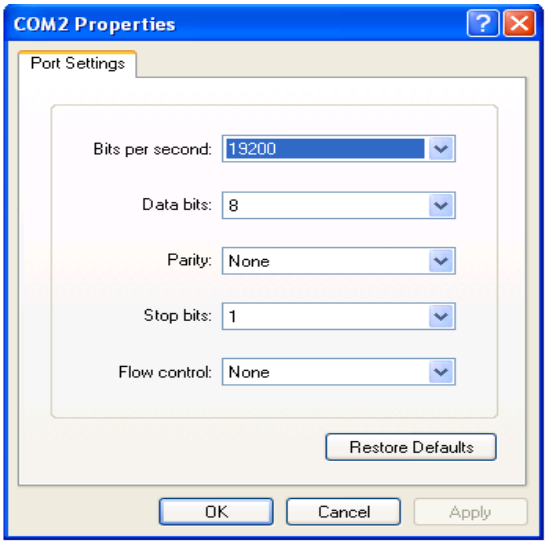
Figure 5.Give a Name to the Connection

4. In the **Connect To** option, select the desired serial port (for example, COM2) from **Connect using** list and click **OK**.

Figure 6.Select the Serial Port

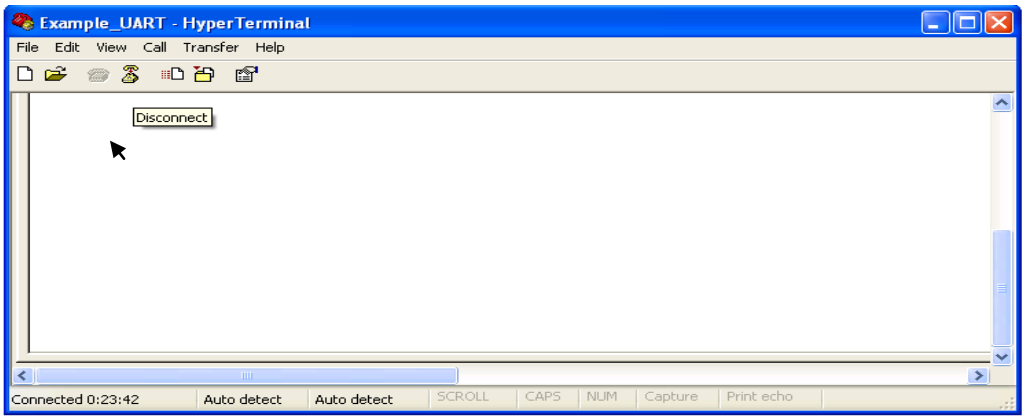
5. In the **COM2** properties, configure the following parameters:
   - ❑ Bits per second = 19200
   - ❑ Data bits = 8
   - ❑ Parity = None
   - ❑ Stop Bits = 1
   - ❑ Flow Control = None
   - ❑ Click **Apply** and then click **OK**.

Figure 7.COM2 Properties Window



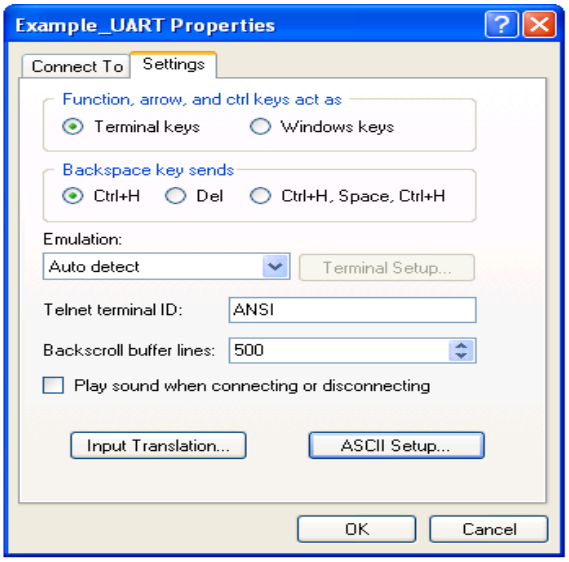
6. At this point, **HyperTerminal** connects to **COM2**.
7. Click **Disconnect**.

Figure 8.Disconnect the Connection



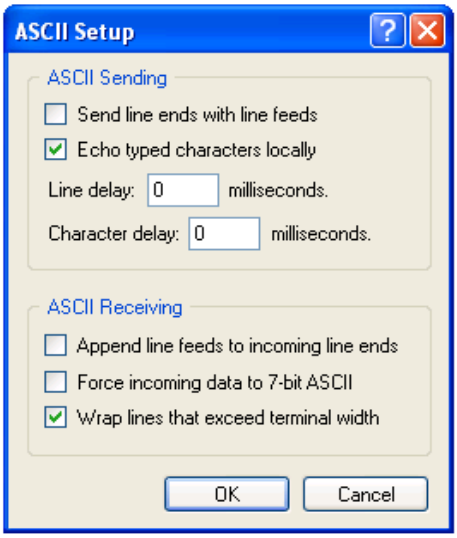
8. Select **File → Properties → Settings** menu and click **ASCII Setup**.

Figure 9.UART Properties Window



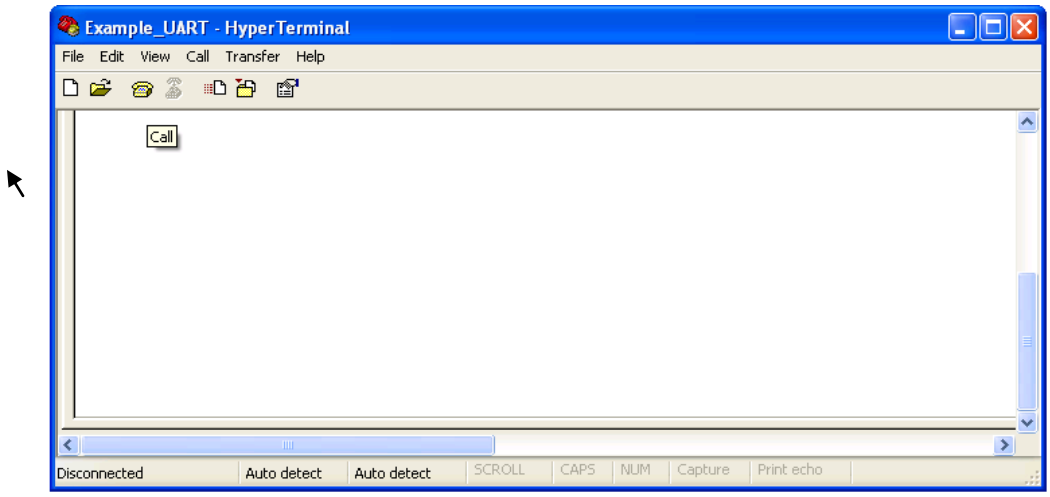
9. Enable **Echo typed characters locally** and click **OK**.

Figure 10.Setting Up ASCII



10. Click **Call**.

Figure 11.Connect to the Serial Port



11. Power-up the PSoC. The **HyperTerminal** displays the welcome screen. Type the command followed by parameters in **HyperTerminal**. PSoC decodes the command and echoes back to **HyperTerminal**.

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