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CE54939 – 8-bit Universal Asynchronous Receiver Transmitter

Objective

The operation of the 8-bit universal asynchronous receiver transmitter (UART) User Module in PSoC®1 is demonstrated in this example.

Overview

A command and some parameters (separated by spaces) are transmitted to PSoC 1 from a PC using a terminal software, through the serial port using the UART protocol. The data is received and decoded by PSoC 1 and the command and parameters are echoed back to the PC (line by line).

Requirements

Tool: PSoC Designer™ 5.4 CP1

Associated Parts: 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, and CY8C28x52

Related Hardware: CY3210 PSoCEval1 kit

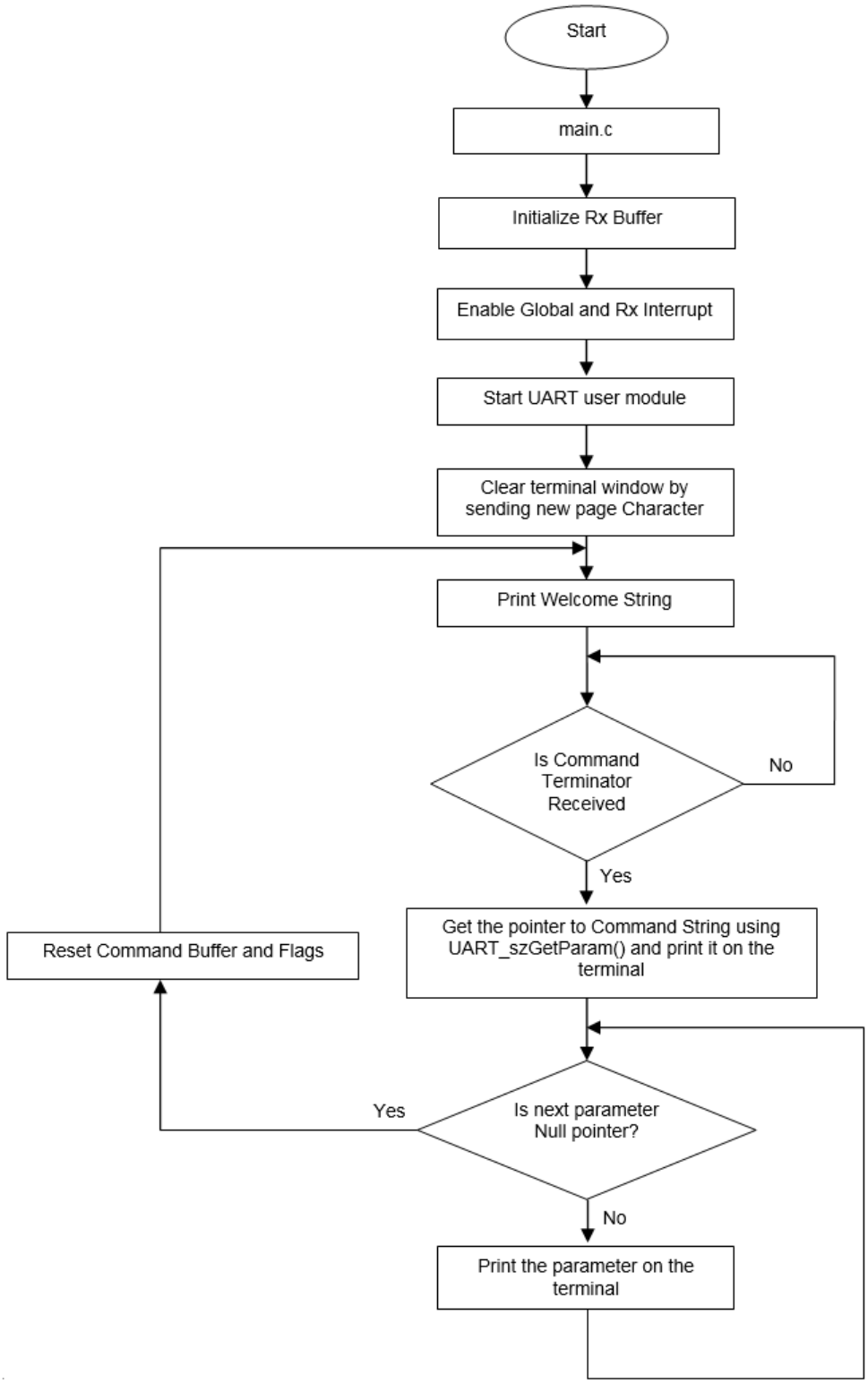
Design

This example demonstrates a UART-based serial communication interface between the PSoC 1 device on the CY3210 PSoCEval1 kit and a PC terminal. The terminal receives and displays UART messages and data from PSoC and is used to enter data from the user using the PC. The data entered from the terminal is received by PSoC and parsed in the format "<command> <parameter1> <parameter2>…" and transmitted back to the terminal. See the Operation section for an example.

The UART User Module enables serial communication in PSoC 1. 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 one-eighth times the clock, that is, 19.2 kbps. Other parameters are set to their most commonly used values; for example, Stop = 1 bit and Parity = none.

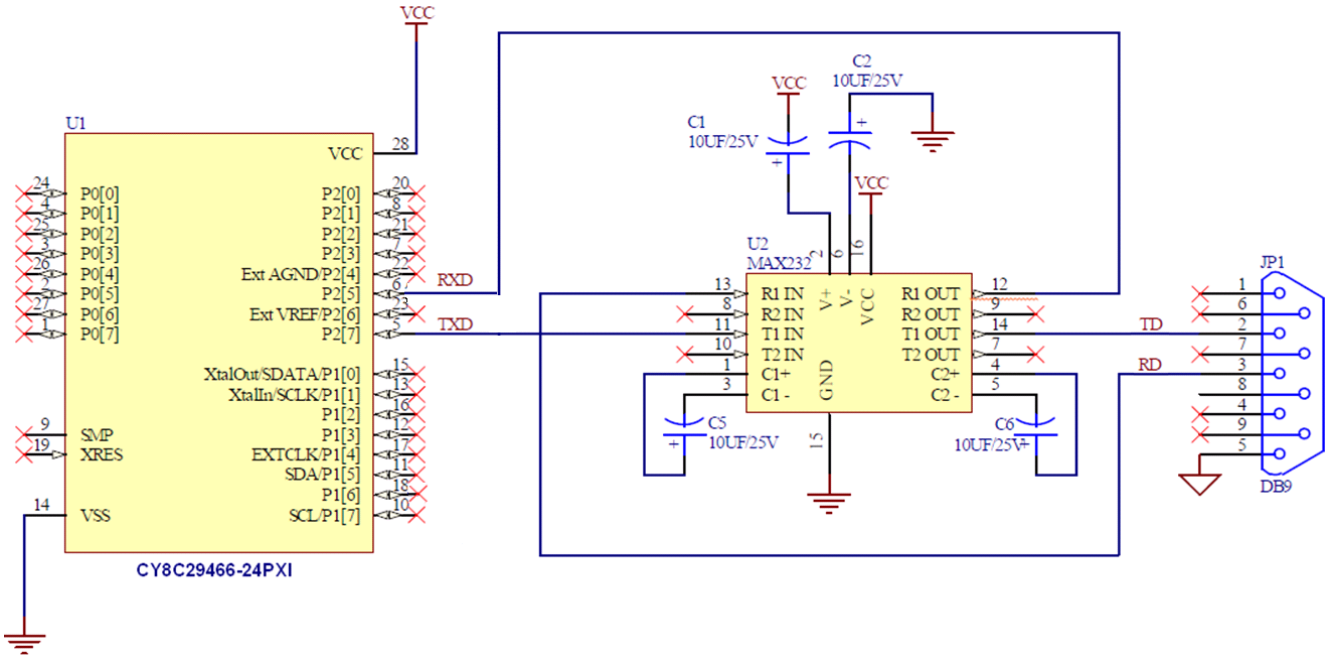
The program execution flow chart is as follows.

Figure 1. Program Execution Flow Chart



Hardware Setup

Figure 2. Schematic Diagram



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

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

The code can be tested using the CY3210 – PSoC Eval1 board. This board has an 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

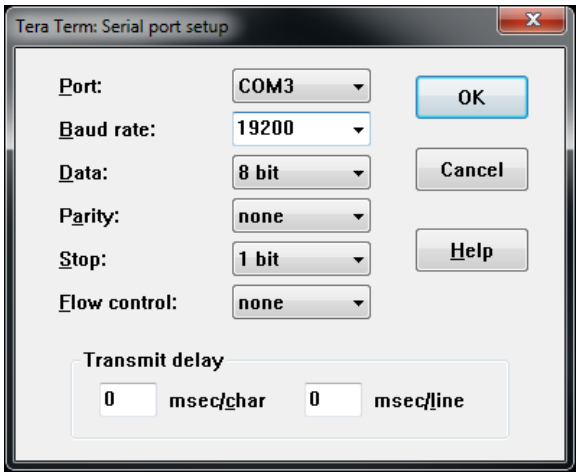
Use **TeraTerm** or any other terminal program to test the project. Configure TeraTerm as follows in Windows.

1. Connect the CY3210 board to the PC serial port using a serial port cable.
2. Start **TeraTerm** from the Windows Start menu**.**

3. Go to **Setup** > **Serial port** and configure the following parameters:
   - Port = select the desired serial port (for example, COM3)
   - Baud rate = 19200
   - Data = 8 bits
   - Parity = None
   - Stop = 1 bit
   - Flow Control = none

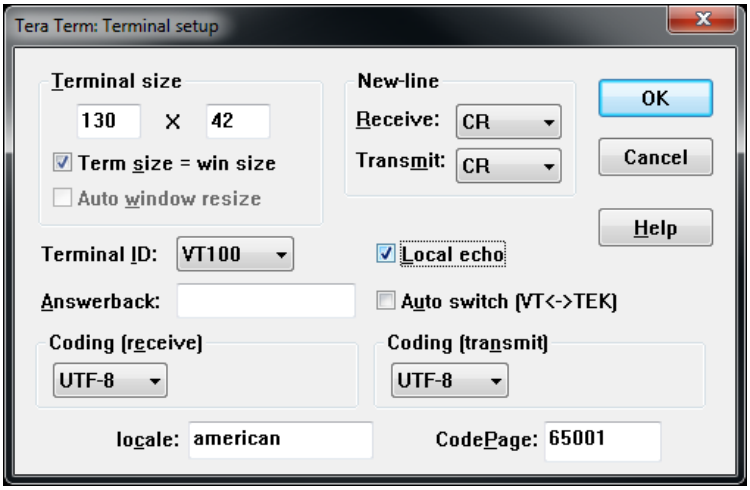
   Click **OK** to apply the settings and connect to the COM port.

Figure 3. Serial Port Setup Window

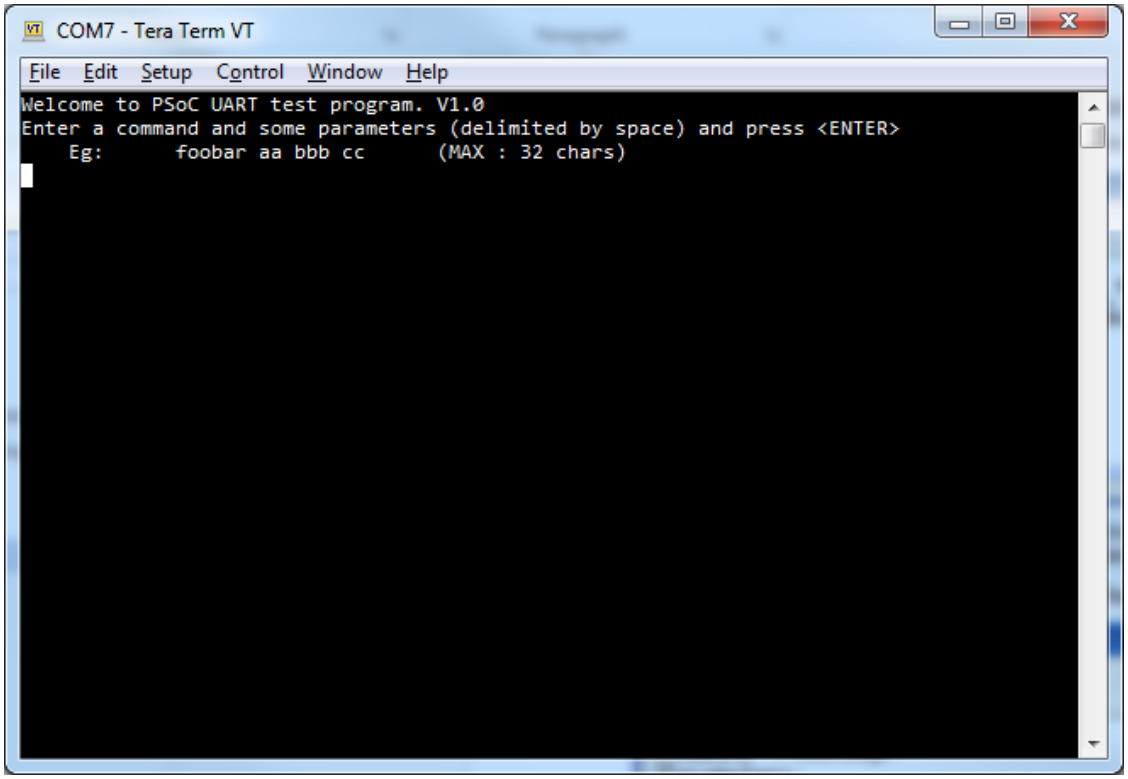


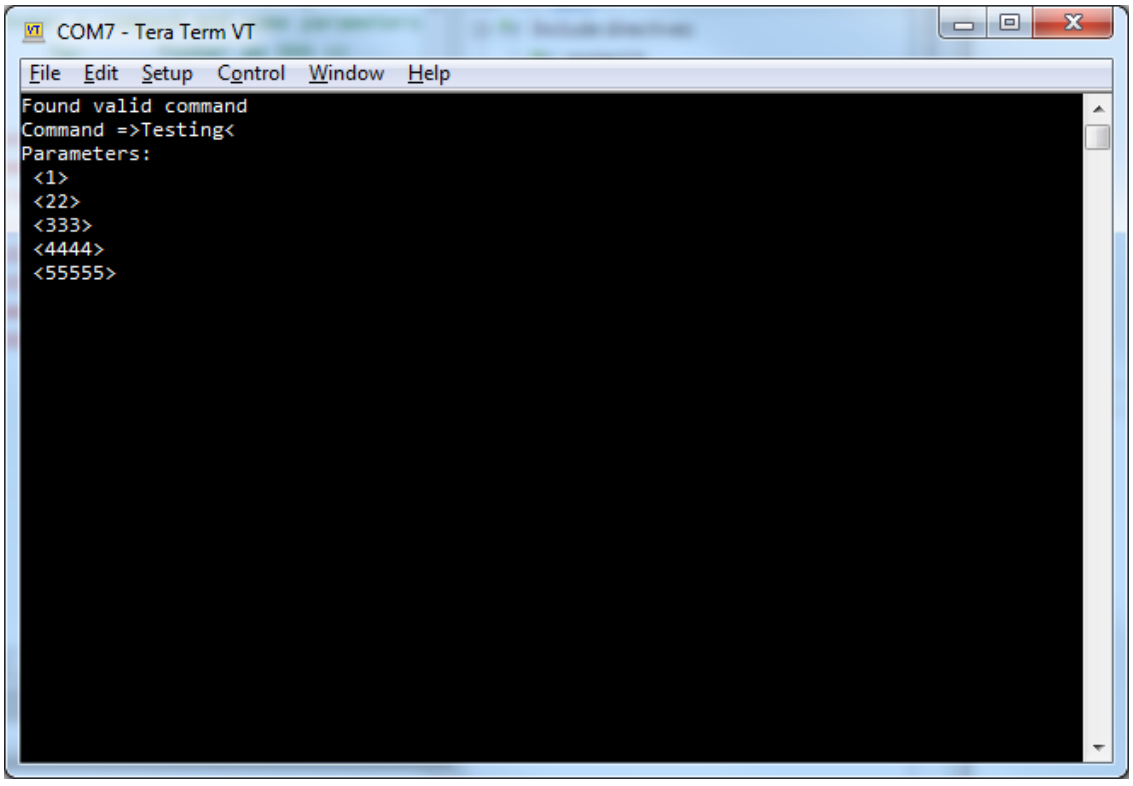
4. Select **Setup > Terminal**. Enable the **Local echo** checkbox and click **OK**.

Figure 4.Setting Up ASCII



5. Power up the CY3210 board. The terminal displays the welcome screen. Type the command followed by parameters in the terminal. PSoC decodes the command and echoes back to the terminal.





The sections that follow discuss the user modules and parameter settings used to make the example.

User Modules

Table 1 lists the user modules used in this example, as well as the placement used by each.

Table 1. PSoC Creator Components

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

Parameter Settings

The following table lists the UART User Module parameter settings.

UART		
Parameter	**Value**	**Comments**
Clock	VC3	Input is a 153.8-kHz clock (eight times baud rate - 19200). VC3 = SysClk / 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 the command buffer and stores the received command in a RAM buffer
RxBufferSize	32	Byte 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 an 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
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 Command Terminator, ParamDelimiter, and IgoneCharsBelow parameters are used by the high-level UART API to process the commands received. When the UART receives the Command Terminator character set, the API reports through a flag that a valid command has been received. When the ParamDelimiter character set is encountered, the API understands that the characters that follow ParamDelimiter are the next parameters in the command. The API ignores any characters below the value set in IgonreCharsBelow 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 the 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

Related Documents

Table 2. Related Documents

Application Notes	
AN75320 Getting Started with PSoC 1	Describes the PSoC 1 architecture and development tools.
PSoC Designer User Module Datasheets	
UART	8-bit Universal Asynchronous Receiver Transmitter that supports duplex RS-232-compliant, data format serial communications over two wires
Device Documentation	
PSoC 1 Datasheets	PSoC 1 Technical Reference Manuals
Development Kit (DVK) Documentation	
PSoC 1 Kits	

Document History

Document Title: CE54939 - 8-bit Universal Asynchronous Receiver Transmitter

Document Number: 001-54939

Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	2746859	DIMA	07/30/2009	New example project.
*A	3002139	DIMA	08/05/2010	1. Updated Software version to PSoC Designer 5.1. 2. Included Related hardware. 3. Included Author name. 4. Included Pin configuration table in page 2.
*B	3250854	DIMA	05/06/2011	Added CE54939 to the header, made minor modifications to the operations section, Updated to PSoC Designer 5.1 FCS.
*C	3340464	DIMA	08/09/2011	Updated to PSoC Designer 5.1 SP2
*D	3719882	RICA	08/22/2012	Removed Example Projects.
*E	4483393	ARVI	08/25/2014	Updated to PSoC Designer 5.4 CP1
*F	5879925	ARVI	09/11/2017	Updated template. Updated document with instructions to set up and use the Teraterm software.

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