

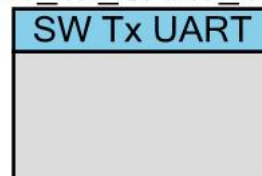
Software Transmit UART

1.50

Features

- Baud rates from 9,600 up to 115,200 bps
- High baud rate accuracy
- Low Flash/ROM resource usage

SW_Tx_UART_1



General Description

The Software Transmit UART (SW_Tx_UART) component is an 8-bit RS-232 data-format compliant serial transmitter.

When to Use a SW_Tx_UART

The SW_Tx_UART component is used to send out serial data in the RS-232 data-format. The component consists solely of firmware and a pin, so it is useful on devices without digital resources, or in projects where all digital resources are consumed.

The SW_Tx_UART supports PSoC 3, PSoC 4, and PSoC 5LP.

Input/Output Connections

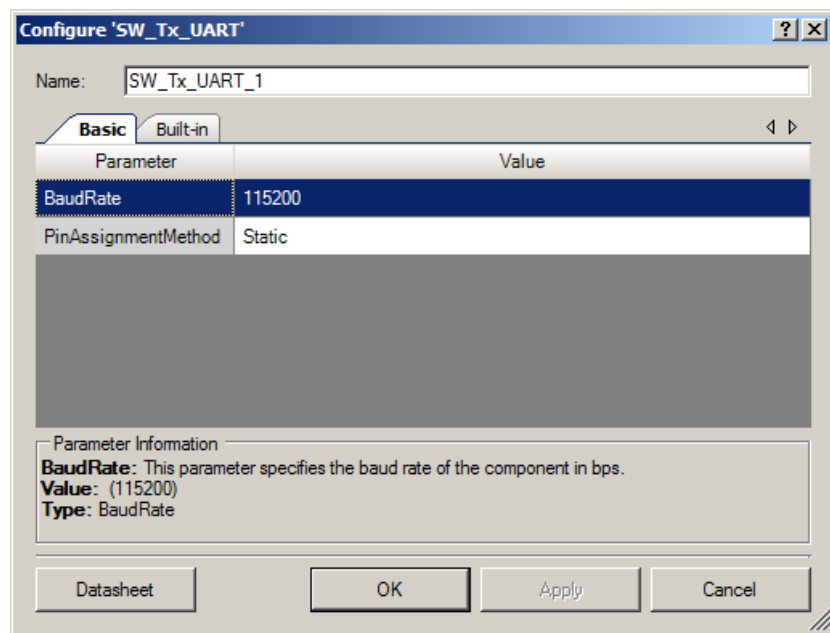
This section describes the various input and output connections for the SW_Tx_UART. An asterisk (*) in the list of I/Os indicates that the I/O may be removed from the component under the conditions listed in the description of that I/O.

Tx – Output*

The Tx output is the serial transmit output of the UART. When configured in static mode this pin is present within the component and assigned to a physical pin using the Pin editor in the Design Wide Resources. When configured in dynamic mode this pin is not present in the component. Instead the pin used is chosen at run-time using the StartEx() function.

Component Parameters

Drag a SW_Tx_UART onto your design and double click it to open the Configure dialog.



The SW_Tx_UART provides the following parameters.

Basic Options

BaudRate

This parameter specifies the baud rate of the component in bps.

Range: 115200, 57600, 38400, 19200, 9600. Default: 115200.

PinAssignmentMethod

This parameter specifies the method by which the component's output pin is assigned. Static indicates that the component will contain a buried pin that will be assigned in the cydwr file. Dynamic requires that the pin be specified via the StartEx() API.

Range: Static, Dynamic. Default: Static.

Application Programming Interface

Application Programming Interface (API) routines allow you to configure the component using software. The following table lists and describes the interface to each function. The subsequent sections cover each function in more detail.

By default, PSoC Creator assigns the instance name "SW_Tx_UART_1" to the first instance of a component in a given design. You can rename it to any unique value that follows the syntactic rules for identifiers. The instance name becomes the prefix of every global function name, variable, and constant symbol. For readability, the instance name used in the following table is "SW_Tx_UART."

Functions

Function	Description
SW_Tx_UART_Start()	Empty function, included for consistency with other components.
SW_Tx_UART_StartEx()	Configures the SW_Tx_UART to use the pin specified by the parameters.
SW_Tx_UART_Stop()	Empty function, included for consistency with other components.
SW_Tx_UART_PutChar()	Sends one byte via the Tx pin.
SW_Tx_UART_PutString()	Sends a NULL terminated string via the Tx pin.
SW_Tx_UART_PutArray()	Sends byteCount bytes from a memory array via the Tx pin.
SW_Tx_UART_PutHexByte()	Sends a byte in Hex representation (two characters, uppercase for A-F) via the Tx pin.
SW_Tx_UART_PutHexInt()	Sends a 16-bit unsigned integer in Hex representation (four characters, uppercase for A-F) via the Tx pin.
SW_Tx_UART_PutCRLF()	Sends a carriage return (0x0D) and a line feed (0x0A) via the Tx pin.



void SW_Tx_UART_Start(void)

Description: Empty function. Included for consistency with other components. This API is not available when PinAssignmentMethod is set to Dynamic.

Parameters: None

Return Value: None

Side Effects: None

void SW_Tx_UART_StartEx(uint8 port, uint8 pin)

Description: Configures the SW_Tx_UART to use the pin specified by the parameters. This API is only available when PinAssignmentMethod is set to Dynamic.

Parameters: port: Port number for dynamic pin assignment
pin: Pin number for dynamic pin assignment

Return Value: None

Side Effects: None

void SW_Tx_UART_Stop(void)

Description: Empty function. Included for consistency with other components.

Parameters: None

Return Value: None

Side Effects: None

void SW_Tx_UART_PutChar(uint8 txDataByte)

Description: Sends one byte via the Tx pin.

Parameters: txDataByte: Byte to send

Return Value: None

Side Effects: None



void SW_Tx_UART_PutString(const char8 string[])

Description: Sends a NULL terminated string via the Tx pin.

Parameters: string: Pointer to the null terminated string to send

Return Value: None

Side Effects: None

void SW_Tx_UART_PutArray(const uint8 data[], uint16/uint32 byteCount)

Description: Sends byteCount bytes from a memory array via the Tx pin.

Parameters: data: Pointer to the memory array
byteCount: Number of bytes to be transmitted (uint16 on PSoC 3, uint32 on PSoC 4 and PSoC 5LP)

Return Value: None

Side Effects: None

void SW_Tx_UART_PutHexByte(uint8 txHexByte)

Description: Sends a byte in Hex representation (two characters, uppercase for A-F) via the Tx pin.

Parameters: txHexByte: The byte to be converted to ASCII characters and sent via the Tx pin.

Return Value: None

Side Effects: None

void SW_Tx_UART_PutHexInt(uint16 txHexInt)

Description: Sends a 16-bit unsigned integer in Hex representation (four characters, uppercase for A-F) via the Tx pin.

Parameters: txHexInt: The uint16 to be converted to ASCII characters and sent via the Tx pin.

Return Value: None

Side Effects: None



void SW_Tx_UART_PutCRLF()

Description: Sends a carriage return (0x0D) and a line feed (0x0A) via the Tx pin.

Parameters: None

Return Value: None

Side Effects: None

MISRA Compliance

This section describes the MISRA-C:2004 compliance and deviations for the component. There are two types of deviations defined: project deviations – deviations that are applicable for all PSoC Creator components and specific deviations – deviations that are applicable only for this component. This section provides information on component specific deviations. The project deviations are described in the MISRA Compliance section of the *System Reference Guide* along with information on the MISRA compliance verification environment.

The Software transmit UART component does not have any specific deviations.

Sample Firmware Source Code

PSoC Creator provides numerous example projects that include schematics and example code in the Find Example Project dialog. For component-specific examples, open the dialog from the Component Catalog or an instance of the component in a schematic. For general examples, open the dialog from the Start Page or **File** menu. As needed, use the **Filter Options** in the dialog to narrow the list of projects available to select.

Refer to the "Find Example Project" topic in the PSoC Creator Help for more information.

Functional Description

The SW_Tx_UART supports 9600, 19200, 38400, 57600, and 115200 bps transfer speeds with no parity bit, 8 data bits, and a single stop bit.

The component consists of a pin and firmware.

If the PinAssignmentMethod is "Static," the pin is buried in the component implementation, and is assigned in the PSoC Creator Pin Editor. If the PinAssignmentMethod is "Dynamic," the pin is assigned and configured using the SW_Tx_UART_StartEx() API. In this configuration, the SW_Tx_UART_StartEx() API must be called before calling any other APIs; otherwise, the component will not function as expected.

The supported baud rates are achieved using a combination of pin writes and software delays, implemented with the CyDelay function. If the CPU clock is changed from the configured frequency, then the CyDelayFreq API must be called before any data transmission.



During transmission, the component masks interrupts to ensure proper timing of signals. Interrupts are restored after a byte is sent; functions that send multiple bytes restore interrupts between each byte. All data transmission functions are blocking.

The component relies on the CPU clock frequency accuracy. For the best baud rate accuracy, the clock source for the CPU clock should be configured to use as accurate a clock source as available.

Software Transmit UART component requires to have Instruction Cache to be enabled for PSoC 3 and PSoC 5LP. This could be done in PSoC Creator project Design-Wide Resources editor on the **System** tab. By default, this option is enabled.

SW_Tx_UART AC Specifications

Parameter	Description	Baud Rate	Min	Typ	Max	Units
f _{CLOCK}	Operating frequency	9600	3	-	67	MHz
		19200	3	-	67	MHz
		38400	6	-	67	MHz
		57600	12	-	67	MHz
		115200	24	-	67	MHz

How to Calculate the Baud Rate Error Value

In the PSoC Creator Clock Editor, the accuracy of each clock source is shown. For example:

System	XTAL	DIGITAL	25.000 MHz	? MHz	±0	-	0	<input type="checkbox"/>	
System	XTAL 32kHz	DIGITAL	32.768 kHz	? MHz	±0	-	0	<input type="checkbox"/>	
System	Digital Signal	DIGITAL	? MHz	? MHz	±0	-	0	<input type="checkbox"/>	
System	USB_CLK	DIGITAL	48.000 MHz	? MHz	±0	-	1	<input type="checkbox"/>	IMOx2
System	ILO	DIGITAL	? MHz	1.000 kHz	-50, +100	-	0	<input checked="" type="checkbox"/>	
System	IMO	DIGITAL	3.000 MHz	3.000 MHz	±1	-	0	<input checked="" type="checkbox"/>	
System	PLL_OUT	DIGITAL	24.000 MHz	24.000 MHz	±1	-	0	<input checked="" type="checkbox"/>	IMO
System	MASTER_CLK	DIGITAL	? MHz	24.000 MHz	±1	-	1	<input checked="" type="checkbox"/>	PLL_OUT
System	BUS_CLK (CPU)	DIGITAL	? MHz	24.000 MHz	±1	-	1	<input checked="" type="checkbox"/>	MASTER_CLK

In this example, the BUS_CLK (CPU) is derived from the IMO, which has an accuracy of +/-1%.

The error in the baud error rate can be calculated as following:

$$\text{Divider} = (\text{int}) (\text{CPU_CLK} + (\text{BaudRate}/2)) / \text{BaudRate}$$

$$\%_{\text{err}} = (\text{BaudRate} - \text{CPU_CLK} / \text{Divider}) * 100\% + \text{CPU_CLK_Accuracy}$$



The first part of the error is with dividing the CPU_CLK down to the baud rate. The second part of the error is the inaccuracy of the CPU_CLK.

API Memory Usage

The component memory usage varies significantly, depending on the compiler, device, number of APIs used and component configuration. The following table provides the memory usage for all APIs available in the given component configuration.

The measurements have been done with associated compiler configured in Release mode with optimization set for Size. For a specific design the map file generated by the compiler can be analyzed to determine the memory usage.

Configuration	PSoC 3 (Keil_PK51)		PSoC 4 (GCC)		PSoC 5LP (GCC)	
	Flash Bytes	SRAM Bytes	Flash Bytes	SRAM Bytes	Flash Bytes	SRAM Bytes
Software Transmit UART	371	8	406	8	378	8

Component Changes

This section lists the major changes in the component from the previous version.

Version	Description of Changes	Reason for Changes / Impact
1.50	Added PSoC 4200L device support.	New device support.
1.40	Assembly code for MDK was updated to require stack alignment to enable usage with ARM MicroLIB.	To support new PSoC Creator option.
1.30	Added support for Bluetooth devices.	Updates to support Bluetooth devices.
1.20	Added support for additional PSoC 4 devices.	To support new silicon.
1.10	Added assembly file for IAR compiler.	To support project export to IAR IDE.
1.0	First component version.	First component version.

© Cypress Semiconductor Corporation, 2015. The information contained herein is subject to change without notice. Cypress Semiconductor Corporation assumes no responsibility for the use of any circuitry other than circuitry embodied in a Cypress product. Nor does it convey or imply any license under patent or other rights. Cypress products are not warranted nor intended to be used for medical, life support, life saving, critical control, or safety applications, unless pursuant to an express written agreement with Cypress. Furthermore, Cypress does not authorize its products for use as critical components in life-support systems where a malfunction or failure may reasonably be expected to result in significant injury to the user. The inclusion of Cypress products in life-support systems application implies that the manufacturer assumes all risk of such use and in doing so indemnifies Cypress against all charges.

PSoC® is a registered trademark, and PSoC Creator™ and Programmable System-on-Chip™ are trademarks of Cypress Semiconductor Corp. All other trademarks or registered trademarks referenced herein are property of the respective corporations.

Any Source Code (software and/or firmware) is owned by Cypress Semiconductor Corporation (Cypress) and is protected by and subject to worldwide patent protection (United States and foreign), United States copyright laws and international treaty provisions. Cypress hereby grants to licensee a personal, non-exclusive, non-transferable license to copy, use, modify, create derivative works of, and compile the Cypress Source Code and derivative works for the sole purpose of creating custom software and or firmware in support of licensee product to be used only in conjunction with a Cypress integrated circuit as specified in the applicable agreement. Any reproduction, modification, translation, compilation, or representation of this Source Code except as specified above is prohibited without the express written permission of Cypress.

Disclaimer: CYPRESS MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARD TO THIS MATERIAL, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Cypress reserves the right to make changes without further notice to the materials described herein. Cypress does not assume any liability arising out of the application or use of any product or circuit described herein. Cypress does not authorize its products for use as critical components in life-support systems where a malfunction or failure may reasonably be expected to result in significant injury to the user. The inclusion of Cypress' product in a life-support systems application implies that the manufacturer assumes all risk of such use and in doing so indemnifies Cypress against all charges.

Use may be limited by and subject to the applicable Cypress software license agreement.

