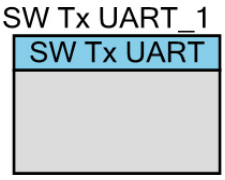
Software Transmit UART

1.0



Features

- Baud rates 9600 up to 115200 bps
- High baud rate accuracy
- Low Flash/ROM resource usage

General Description

The Software Transmit (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.

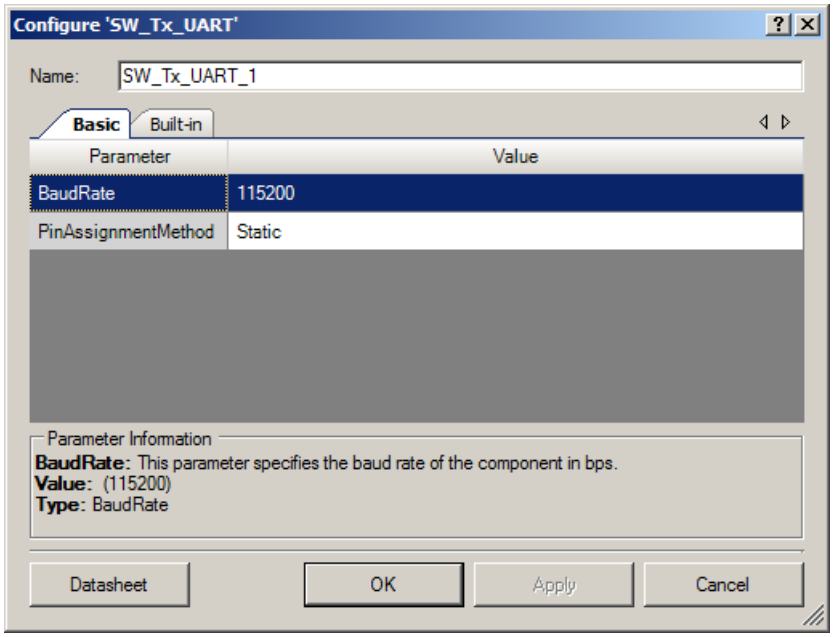
The SW Tx UART supports PSoC 3, PSoC 4 and PSoC 5LP.

Input/Output Connections

There are no I/O connections for the Software Transmit UART component. It is an API only.

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 single stop bit.

The component consists of a pin and firmware.

If PinAssignmentMethod is “Static,” the pin is buried in the component implementation with the correct settings (Digital Output, no HW connection, initial value = ‘1’), and is assigned in the Pin Editor in the DWR in PSoC Creator. If PinAssignmentMethod is “Dynamic,” the pin is assigned and configured using the SW_Tx_UART_StartEx() API. This API sets the Drive Mode to Strong Drive and writes a ‘1’ to the DR register, and saves a pointer to the DR register in a static global variable. In case if PinAssignmentMethod is “Dynamic” user must ensure that SW_Tx_UART_StartEx() API is called before calling any other APIs, otherwise component will not function as expected.

The supported baud rates are achieved using a combination of pin writes and CyDelays. If the CPU clock was changed - CyDelayFreq API should 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 in between every byte. All data transmission functions are blocking.

Component completely relies on CPU frequency accuracy, so to improve baud rate accuracy clock tree should be configured to feed as much as possible accurate CPU clock.

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 baud rate error value

In PSoC Creator DVR editor each clock source has its accuracy value, for example:

System	XTAL	DIGITAL	25.000 MHz	? MHz	±0	-	0	☐	
System	XTAL 32kHz	DIGITAL	32.768 kHz	? MHz	±0	-	0	☐	
System	Digital Signal	DIGITAL	? MHz	? MHz	±0	-	0	☐	
System	USB_CLK	DIGITAL	48.000 MHz	? MHz	±0	-	1	☐	IMOx2
System	ILO	DIGITAL	? MHz	1.000 kHz	-50, +100	-	0	☑	
System	IMO	DIGITAL	3.000 MHz	3.000 MHz	±1	-	0	☑	
System	PLL_OUT	DIGITAL	24.000 MHz	24.000 MHz	±1	-	0	☑	IMO
System	MASTER_CLK	DIGITAL	? MHz	24.000 MHz	±1	-	1	☑	PLL_OUT
System	BUS_CLK (CPU)	DIGITAL	? MHz	24.000 MHz	±1	-	1	☑	MASTER_CLK

BUS_CLK(CPU_CLK) has clock from IMO, which has accuracy +/-1%.

The baud error rate can be calculated as following:

Divider = (CPU_CLK+(BaudRate/2))/BaudRate

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

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
1.0	First component version.	First component version.