Hibernate & Stop Power Modes Example Project
1.00

Features

- Hibernate and Stop Low Power Modes
- SRAM retention in Hibernate mode
- Demonstrates freezing of GPIO pins in Hibernate and Stop mode

General Description

This example project is a PSoC Creator starter design. It shows how you can use PSoC 4 to enter and wake up from hibernate and stop low power modes. It also shows how to retain SRAM variables in hibernate mode. This project demonstrates it using a UART through which user can send command to increment or decrement a variable, or enter hibernate and stop low power modes. Hibernate and Stop modes can also be entered using the same switch during active mode.

Development Kit Configuration

The following configuration instructions provide a guideline to test this design. For simplicity, the instructions below describe the stepwise process to be followed when testing this design with the PSoC 4 Pioneer Kit (CY8CKIT-042). However, this starter design can be validated on any other PSoC 4 development kit. Please refer to the "Schematic and Pin mapping" section at the end of this document for details.

1. Set Jumper J9 to 3.3V position.
2. Connect Pin_Stop (P1[5]) to oscilloscope.
3. Connect threshold DC voltage to Inverting terminal of Low Power Comparator (P0[1]).
4. Connect a potentiometer (VR) to Non-Inverting terminal of Low Power Comparator (P0[0]) as Figure 1 shows.
5. Connect P0[4] and P0[5] to the Rx and Tx terminals (Pin P12[7] and P12[6]) on the header J8.
6. Connect USB cable to the PSoC 4 Pioneer Kit DVK and PC with HyperTerminal program.

Project Configuration

This example project shows how you can use PSoC 4 to enter and wake up from hibernate and stop low power modes. PICU and Low Power Comparator interrupts are used as wakeup sources to bring back the device from hibernate mode. Dedicated Wake-up pin (P0[7]) is used as wake-up source to bring back the device from stop mode. Same pin can be used to enter low power mode from active mode. Digital pins are used to show GPIO retention during low power modes and UART component is used to send the commands to PSoC 4. Mode transition is indicated by Pin_LowPowerOut, which is set to high in active mode and is cleared in low power modes. This pin also indicates wrong command from UART by blinking once. Pin_Stop is set to high when device enters stop mode and is cleared in active and hibernate mode.

The top design schematic is shown in Figure 1.

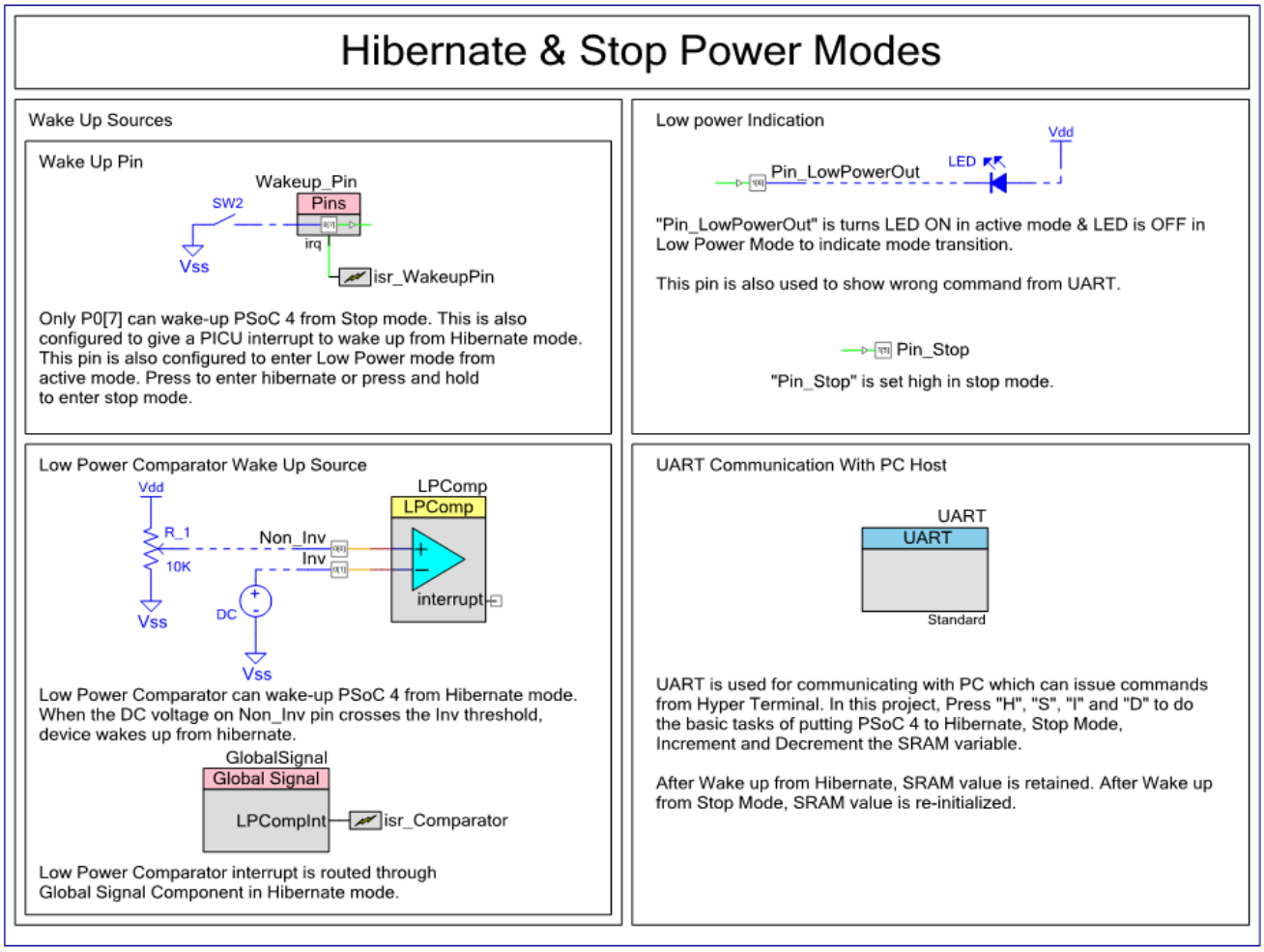

Figure 1. Top Design Schematic – Hibernate & Stop Power Modes

Wakeup Pin (P0[7]) is connected to SW2 and is configured to generate a PICU interrupt to enable PSoC 4 to wake up from Hibernate as well as Stop mode. Low Power Comparator is

configured to generate interrupt when the voltage on non-inverting terminal exceeds voltage on inverting terminal and in this project is set in low-power mode to consume less power. Low Power Comparator interrupt is routed through Global Signal component when the device is in hibernate mode.

UART is configured in “Full Duplex” mode to receive commands from the terminal and displaying the executed results on the terminal. Full configuration of UART is as shown in Figure 2. Use the same settings in hyper terminal to communicate with PSoC 4 properly.

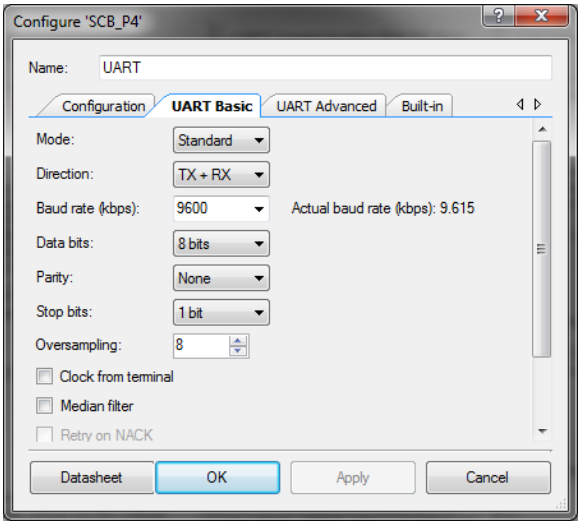

Figure 2. UART Configuration

Project Description

In the main function, it checks for the source of reset (Hibernate or Stop) and initializes components accordingly. Read the command from UART terminal and execute it.

UART command description:

1. ‘I’ – Increments the SRAM variable
2. ‘D’ – Decrements the SRAM variable
3. ‘H’ – Enter Hibernate power mode
4. ‘S’ – Enter Stop mode

SRAM variable retains its value when it wakes up from hibernate mode and is reset when the device wakes up from Stop mode.

To enter low power mode from active mode without using UART communication, press the wakeup switch as explained below:

a. Press the switch to enter hibernate mode from active mode
b. Press and hold the switch to enter stop mode from active mode

Expected Results

Program the device with the project and connect as per the Development Kit Configuration Section. Send commands from Hyper Terminal to PSoC 4. Send ‘H’ or ‘S’ to enter Hibernate or Stop mode, respectively and press SW2 (P0[7]) on the kit to wakeup device. PSoC sends back current count values (SRAM variable) on each command. Send ‘I’ or ‘D’ to increment or decrement the variable.

Use wakeup switch to enter low power mode as explained above.

Pin_LowPowerOut is set to HIGH in active mode and is cleared in low power mode. This pin blinks if device receives wrong command from UART terminal. Pin_Stop is set to high in stop mode and is cleared in active and hibernate modes.

Hyper Terminal is cleared after every new command.

Figure 3 shows screen-shot of how your terminal looks like when you send commands from it.

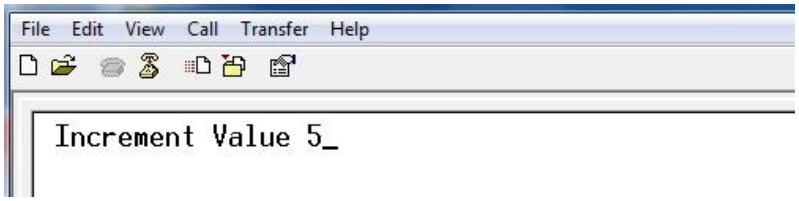

Figure 3. Terminal Screenshot

Figure 4 shows the LED connected to Pin_LowPowerOut is switched ON which shows the device is in active power mode. This goes OFF if the device enters low power mode.

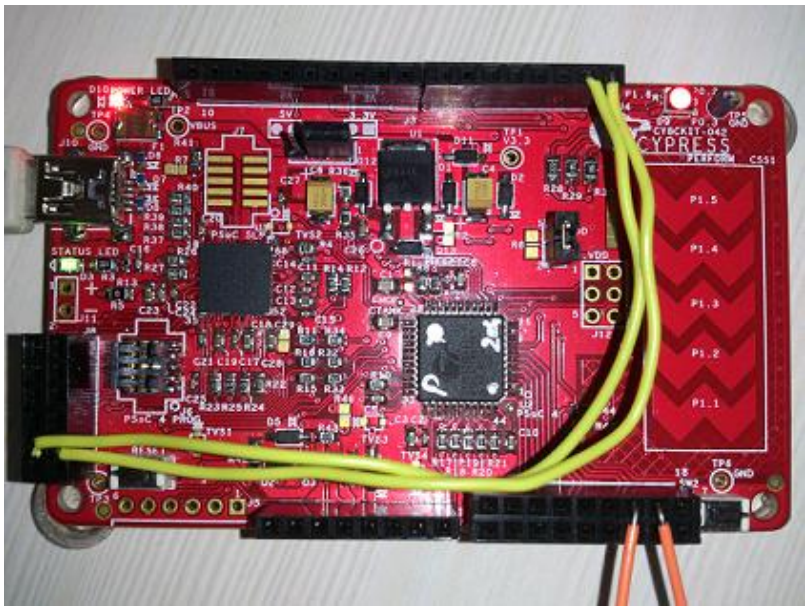

Figure 4. LED showing active mode

Schematic and Pin Mapping

Schematic:

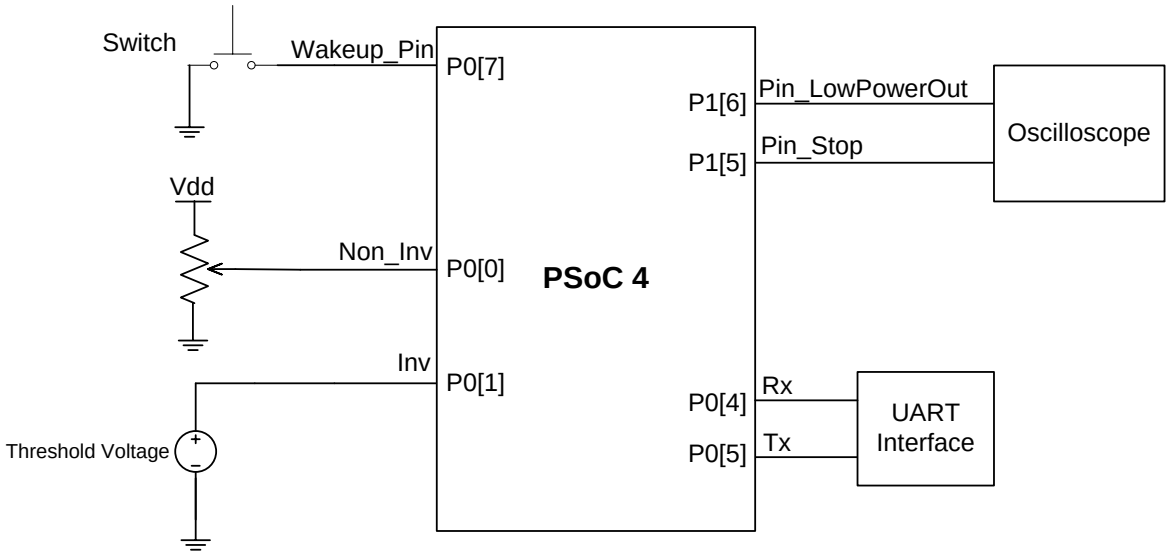

Figure 5. Connection Schematic

Pin Mapping Table:

Refer Table 1 to validate this starter design on any other PSoC 4 development kit:

S.No.	I/O Signals	Project Pin Assignments	Other Possible Connections
1	Wake-up Pin	P0[7]	Fixed to P0[7]
2	Non_Inv and Inv inputs of Low Power Comparator	P0[0] and P0[1]	P0[0] and P0[1] or P0[2] and P0[3]
4	Rx and Tx (UART Interface)	P0[4] and P0[5]	P3[0] and P3[1] or P0[4] and P0[5]
3	Low Power Indicator Pins (Pin_LowPowerOut and Pin_Stop)	P1[6] and P1[5]	Any GPIO except Pin P0[7]

Table 1: Available connections for the I/O signals

Note: If Low Power Indicator Pins are connected to active high LEDs, please write "LOW" to the pin to turn it off instead of writing "HIGH" and vice-versa. The section of the code that needs to be changed in “main.c” is mentioned below:

```
/* Turn the LED connected to Pin_LowPowerOut OFF to indicate low power mode */
        Pin_LowPowerOut_Write(HIGH);
/* Turn the LED connected to Pin_LowPowerOut ON to indicate active mode */
        Pin_LowPowerOut_Write(LOW);
```

Using UART to communicate with PC Host

This example project communicates with a PC host using UART. A HyperTerminal program is required in the PC to communicate with PSoC 4. If you don’t have a HyperTerminal program installed, download and install any serial port communication program. Free wares such as HyperTerminal, Bray’s Terminal etc. are available on web.

Follow these steps to communicate with PC host.

1. Connect the USB cable between the PC and PSoC 4 Pioneer Kit.
2. Open the device manager program in your PC, find the COM port in which the PSoC 4 is connected, and note the port number.
3. Open the HyperTerminal program and select the COM port in which the PSoC 4 is connected.
4. Configure Baud rate, Parity, Stop bits and Flow control information in the HyperTerminal configuration window. These settings should match the configuration of the PSoC Creator UART component in the project
5. Start communicating with the device as explained in the project description.

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