# Verifying the Accuracy of sleep() and usleep()

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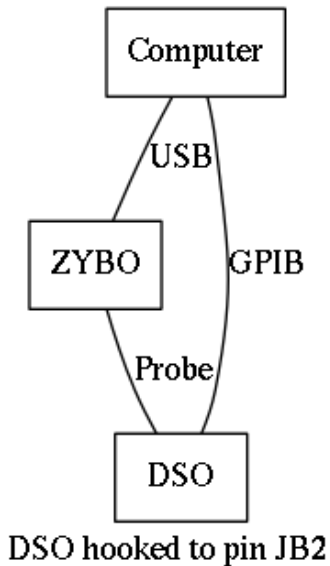
Using the ZYBO Private Timer & DSO:

- Verify the accuracy of both functions
- Compare accuracy of the private timer and DSO

## Objectives

Using the ZYBO Private Timer & DSO:

- Verify the accuracy of both functions
- Compare accuracy of the private timer and DSO
- Determine delay to set a pin high/low

# Functional Block Diagram



DSO hooked to pin JB2

# Functionality

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- Once finished, the ZYBO sends sleep value to C#
- C# reads all data off the DSO
- C# finds all data that is high

## Tests

20 Total Tests

- 10 tests per function
- Values per test range from low to high
- 10 data points per test
- Private timer and DSO data is collected simultaneously

## sleep Data for Private Timer

| Time | Average Measured | Standard Deviation | Percent Error |
|------|------------------|--------------------|---------------|
| 1 | 1 | 1.542 E-08 | 4.471 E-05 |
| 2 | 2 | 1.369 E-08 | 2.005 E-05 |
| 3 | 3 | 1.707 E-08 | 1.476 E-05 |
| 5 | 5 | 1.897 E-08 | 8.818 E-06 |
| 7 | 7 | 2.088 E-08 | 5.960 E-06 |
| 10 | 10 | 1.257 E-08 | 4.575 E-06 |
| 13 | 13 | 1.537 E-08 | 3.207 E-06 |
| 20 | 13.22 | 0 | -33.92 |
| 30 | 13.22 | 0 | -55.95 |
| 40 | 13.22 | 0 | -66.962 |

*Note: Time, Average Measured, and Standard Deviation are in seconds*

## sleep Data for DSO

| Time | Average Measured | Standard Deviation | Percent Error |
|------|------------------|--------------------|---------------|
| 1    | 0.989            | 1.17 E-16          | -0.01         |
| 2    | 1.98             | 0                  | -1            |
| 3    | 2.971            | 2.846 E-02         | -0.9667       |
| 5    | 4.95             | 9.362 E-16         | -1            |
| 7    | 6.96             | 2.108 E-02         | -0.5714       |
| 10   | 9.9              | 1.872 E-15         | -1            |
| 13   | 12.95            | 0                  | -0.3846       |
| 20   | 19.8             | 3.745 E-15         | -1            |
| 30   | 29.8             | 3.745 E-15         | -0.6667       |
| 40   | 39.8             | 7.49 E-15          | -0.5          |

*Note: Time, Average Measured, and Standard Deviation are in seconds*

## usleep Data for Private Timer

| Time | Average Measured | Standard Deviation | Percent Error |
|------|------------------|--------------------|---------------|
| 1u | 1.405 E-06 | 1.452 E-08 | 40.46 |
| 5u | 5.394 E-06 | 6.454 E-09 | 7.889 |
| 10u | 1.043 E-05 | 3.163 E-08 | 4.28 |
| 15u | 1.547 E-05 | 1.038 E-08 | 3.128 |
| 20u | 2.043 E-05 | 3.773 E-08 | 2.166 |
| 100u | 1.004 E-04 | 1.88 E-08 | 0.4358 |
| 1m | 1 E-03 | 1.263 E-08 | 4.252 E-02 |
| 1.25m | 1.25 E-03 | 2.211 E-08 | 3.621 E-02 |
| 10m | 1 E-02 | 1.175 E-08 | 4.286 E-03 |
| 100m | .1 | 1.869 E-08 | 4.514 E-04 |

*Note: Time, Average Measured, and Standard Deviation are in seconds*

## usleep Data for DSO

| Time | Average Measured | Standard Deviation | Percent Error |
|------|------------------|--------------------|---------------|
| 1u | 1.444 E-06 | 8.433 E-09 | 44.4 |
| 5u | 5.44 E-06 | 2.108 E-08 | 8.8 |
| 10u | 1.05 E-05 | 6.667 E-08 | 5 |
| 15u | 1.551 E-05 | 3.162 E-08 | 3.4 |
| 20u | 2.044 E-05 | 1.265 E-07 | 2.2 |
| 100u | 1.005 E-04 | 5.27 E-07 | 0.5 |
| 1m | 1.001 E-03 | 3.162 E-06 | 0.1 |
| 1.25m | 1.252 E-03 | 1.033 E-05 | 0.16 |
| 10m | 1 E-02 | 1.829 E-18 | 0 |
| 100m | 9.36 E-02 | 5.164 E-04 | -6.4 |

*Note: Time, Average Measured, and Standard Deviation are in seconds*

## Conclusion

|         | SD Private Timer | SD DSO      |
|---------|------------------|-------------|
| Max     | 3.773 E-08       | 2.846 E-02  |
| Min     | 6.454 E-09       | 0           |
| Average | 1.757 E-08       | 2.504 E-03  |

|         | Error Private Timer | Error DSO |
|---------|---------------------|-----------|
| Max     | 40.46               | 44.4      |
| Min     | 3.207 E-06          | 0         |
| Average | 3.438               | 2.504     |

*Note: Standard Deviations are in seconds*

## Conclusion

- Delay from Private Timer: about 43.21ns on average
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```
XScuTimer_LoadTimer(&TimerInstance, CntValue1);
XScuTimer_Start(&TimerInstance);
XGpio_DiscreteWrite(&SleepSignal, 1, 1);

sleep(sleepTime);

CntValue2 = XScuTimer_GetCounterValue(&TimerInstance);
XScuTimer_Stop(&TimerInstance);
XGpio_DiscreteWrite(&SleepSignal, 1, 0);
```