AN2783

FreeRTOS™ Using Percepio® Trace on ATmega4809

Features

- Running a FreeRTOS™ Demo with Trace Support on the ATmega4809
- Demonstrates Responsiveness of the System even if CPU is 100% Loaded
- Using Data Visualizer to Log Data from UART
- Live Streaming of Debug Data into Percepio® Tracealyzer 4

Introduction

The example application provides a port of the FreeRTOS kernel and demonstrates how to build a basic application using the ATmega4809 AVR® microcontroller, and how to trace the code run time using Percepio Tracealyzer 4.

Having trace capabilities gives you real-time insight into the behavior of the system to ease development, debugging, validation and optimization of the code.

- Runs at 3.3V and 10 MHz
- The application will blink LED0 on ATmega4809 Xplained Pro
- Use SW0 on the ATmega4809 Xplained Pro to toggle between views on the OLED display
- Use SW1 on the ATmega4809 Xplained Pro to trigger an external interrupt
- **Welcome View**
  - Displays device and FreeRTOS information
  - Displays how to switch between views and trigger the ISR
  - When the Welcome view is active, the buttons on the OLED1 Xplained Pro have no function
- **Time and Temperature View**
  - Displays time and temperature of the device
  - In this view, while holding down Button 2 it is possible to adjust the time using Button 1 (hours) and Button 3 (minutes)
- **Bubble Sort and Quick Sort Views**
  - In both these views, 100% of the CPU is used for sorting unless any higher or same priority tasks are ready
  - The OLED displays in text and bar graph how many sorts/sec the device can do on a array of 30 integers
  - The user can keep the CPU busy by pushing buttons 1-3 multiple times and see the bar graph change as sorts/sec goes down
  - Pushing SW1 will suspend the current sorting task and update the OLED display
  - Pushing SW1 again will resume the task

Table of Contents

1. Prerequisite

The following sections discuss the hardware and software needed to run this demonstration.

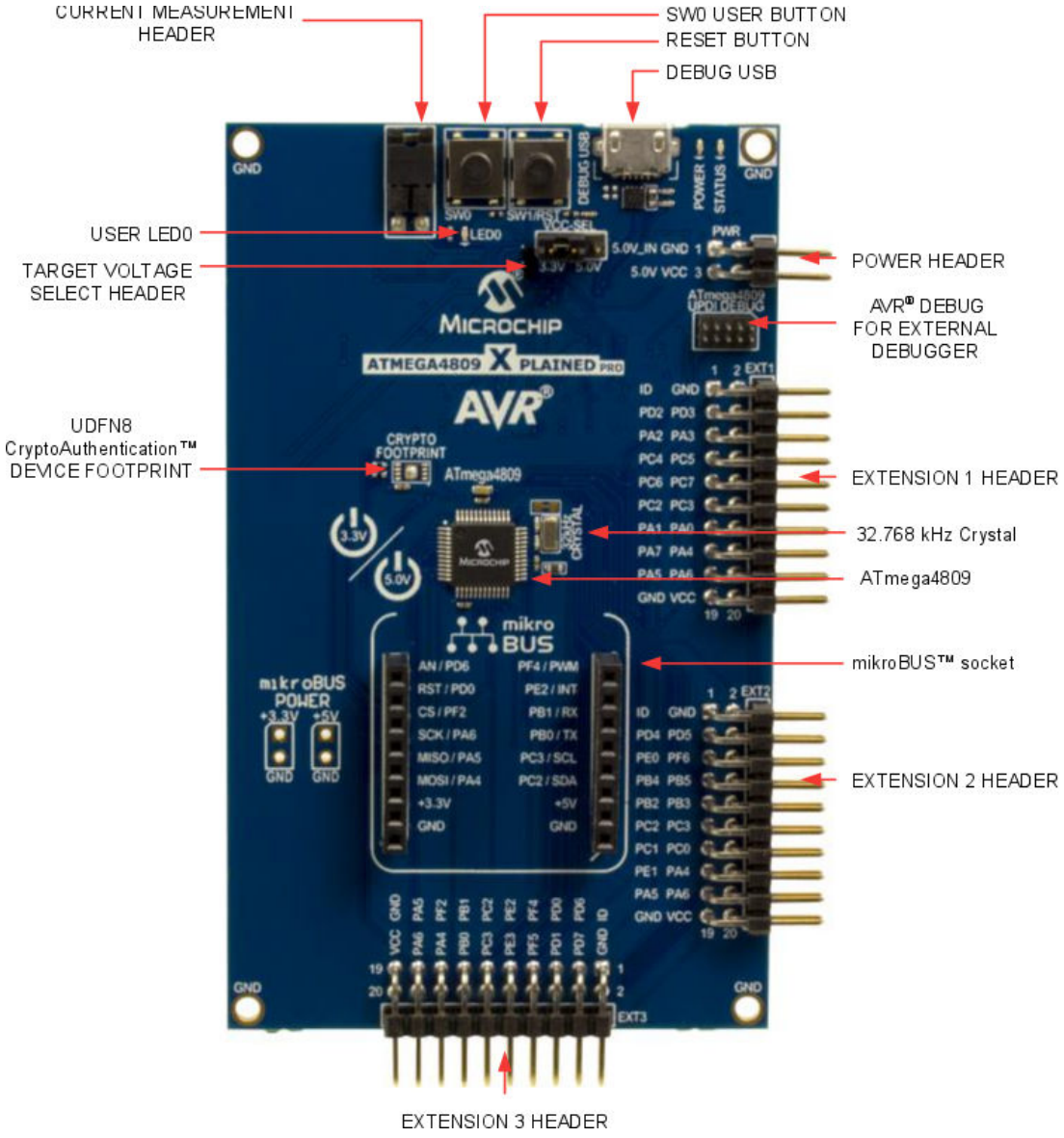
1.1 Hardware

The required hardware and settings are:

- ATmega4809 Xplained Pro
- OLED1 Xplained Pro connected to Extension 3 Header
- ATmega4809 Xplained Pro Target Voltage Selection Header set to 3.3V

Warning: Running target voltage above 3.6V will damage the OLED1 Xplained Pro.

Figure 1-1. ATmega4809 Xplained Pro Overview



1.2 Software

Here are the software items needed to run this demonstration.

Atmel Studio with Data Visualizer

Percepio Tracealyser for FreeRTOS

1.3 Documentation

Here are some additional documents to help you with this demonstration.

ATmega4809 Xplained Pro kit documentation

OLED1 Xplained Pro User Guide

FreeRTOS documentation

Data Visualizer

Percepio Tracealyzer

2. CPU Utilization Running Trace

The time spent by the CPU doing trace and trace-related work is variable. The trace code will send data each time the context is switched, so heavy task switching will create more trace data, thus more time is spent in trace code and sending the data over UART. Consequently the UART speed will also affect the amount of time spent doing trace and trace-related work.

Typical number of reported sorts per second for Bubble and Quick sort are summarized below.

Table 2-1. Sorting Speeds in Iterations per Second

	Trace Enabled (TE)	Trace Disabled (TD)
Bubble Sort	680 ± 4	706 ± 2
Quick Sort	1638 ± 10	1694 ± 2

From the results listed above the trace related CPU load can be estimated as $TraceLoad = \frac{TD - TE}{TE} \cdot 100\,\%$. This gives an approximation of percentage of CPU time spent on trace activity since in these modes sorting and trace consume close to 100% of the total CPU time.

Table 2-2. Calculated Trace CPU Load

Bubble Sort	Quick Sort
3.8 ± 0.3%	3.4 ± 0.5 %

Trace can be turned off by commenting out the line in FreeRTOSConfig.h

```
#define _trace_enabled_
```

Remember to **Clean Solution** and **Rebuild Solution** in Atmel Studio after doing changes in FreeRTOSConfig.h.

3. Running the Demo

1. Install software needed
2. Unzip project and open in Atmel Studio 7
3. Ensure that the Target Voltage Selector Header (VCC-SEL) is set to 3.3V and connect the hardware
4. In Atmel Studio 7, select *Debug->Start Debugging and break (Alt + F5)*
5. Start Data Visualizer from Atmel Studio 7, *Tools->Data Visualizer*
6. In the Data Visualizer window, open *Configuration->External Connections-> Serial Port*
   - Select EDBG Virtual COM port (COMxx) in drop down menu
   - No parity
   - 8-bit character size
   - 1 stop bit
   - 1250000 baud-rate
   - Click Connect button
7. In Data Visualizer window, open *Configuration->Utilities-> File Logger*
   - Connect the data source from Serial Port Control Panel to Log to File
   - Select RAW as file type
   - Browse and create a file name ending with .psf
   - Click the Start button
8. Start Tracealyzer 4
   - Go to *File-> Live Stream->Settings->PSF Streaming Settings*
   - Choose File System in Target Connections, browse and select the file created in previous step, apply and OK
   - Connect and Start Session
9. In Atmel Studio 7, *Continue(F5) debugging*
10. Demo is running and debug data should appear live in Tracealyzer

Figure 3-1. Atmel Studio view

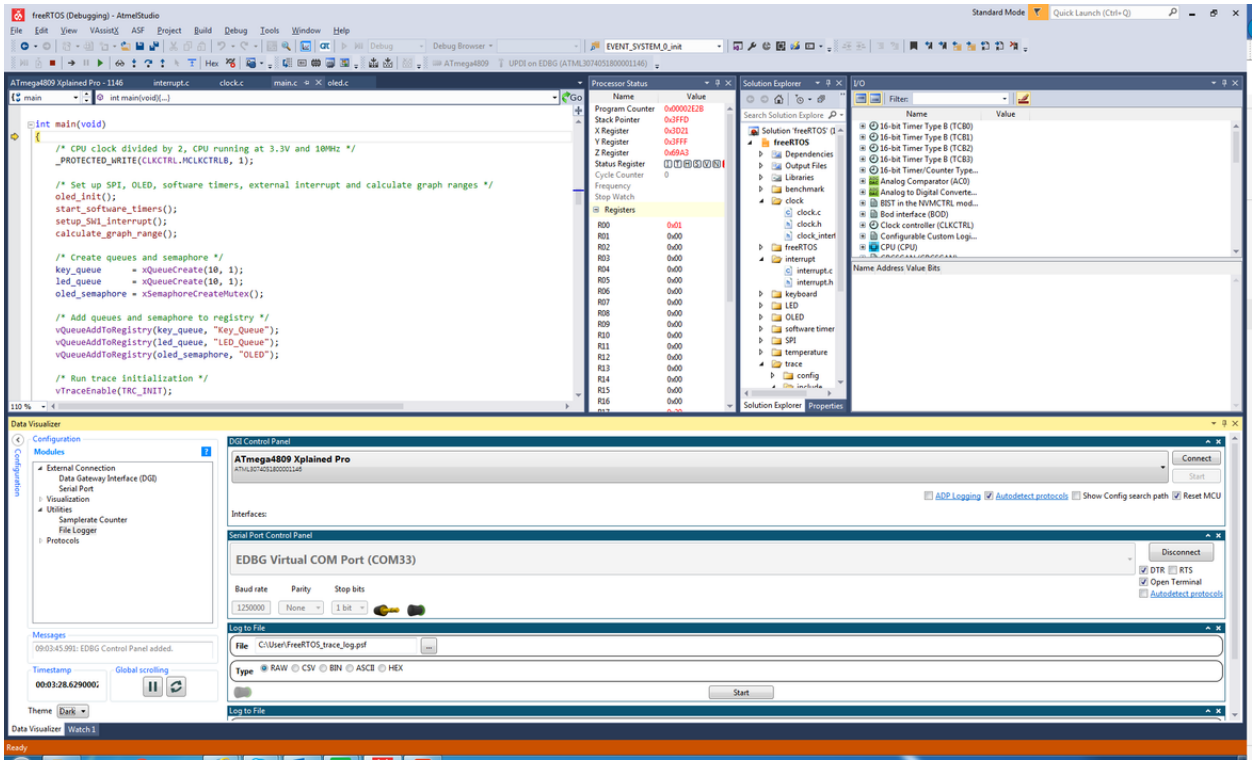
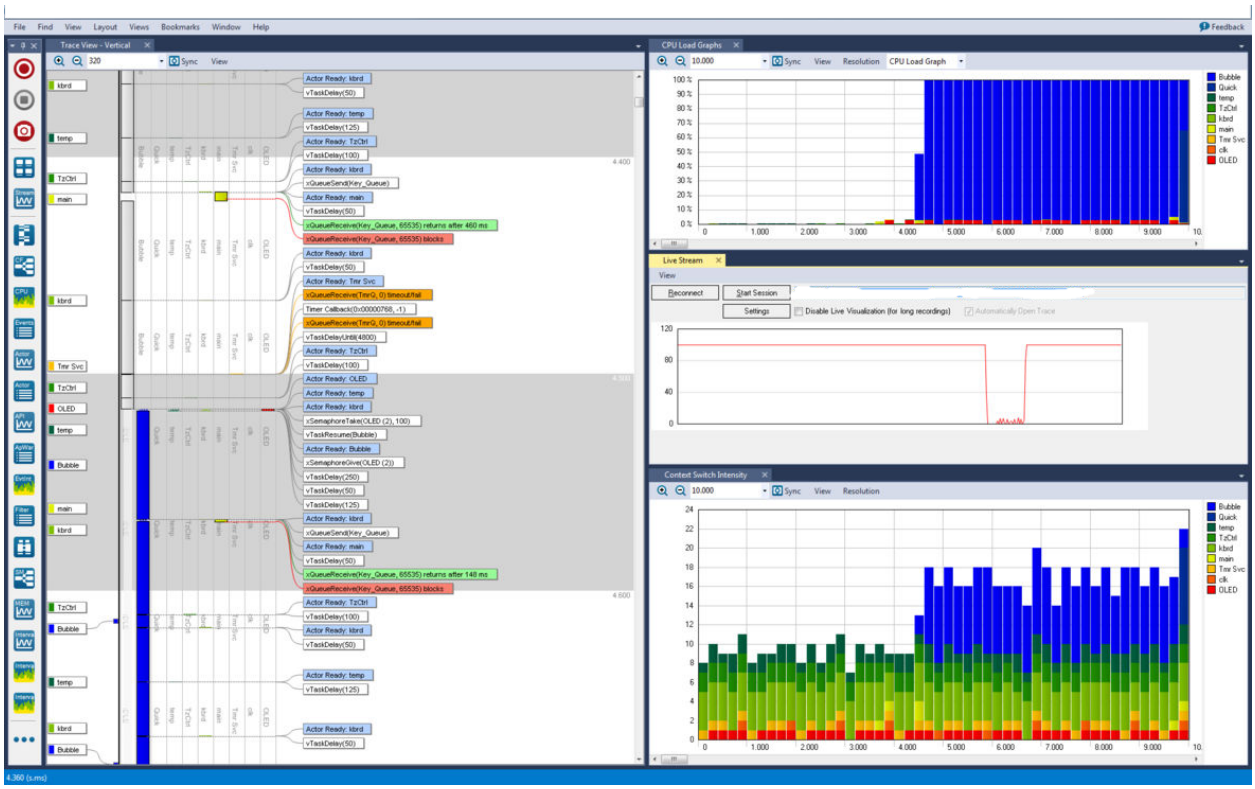


Figure 3-2. Tracealyzer view



4. Summary

The application note has demonstrated how to use trace in a FreeRTOS application running on an ATmega4809 AVR® microcontroller. Using trace will have an impact on the CPU load as shown in the CPU utilization chapter, but the benefit in having trace capability and getting real-time insight into the behavior of the system will surpass the extra CPU load. Trace is typically only used during development, debugging, validation and optimization of the code and not used when the application is done.

5. Revision History

Revision	Date	Comments
A	8/2018	Initial revision of this document

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