RX610 Group

RX-Stick Dhrystone Benchmark

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Introduction

The following document describes how to run the Dhrystone benchmark RX-Stick Quick Demo.

Target Device

RX610

Contents

1. Introduction

The RX architecture sets a new benchmark for MCU performance, offering 1.65 DMIPS/MHz and incorporating powerful features such as an on-chip Floating Point Unit (FPU), DSP-like instructions, and execution from zero wait state flash memory up to 100 MHz. These features make it possible to use the RX for demanding applications that previously were the domain of DSP's.

A common benchmark used to measure the performance of CPUs is the Dhrystone benchmark. This application note details running the RX-Stick Dhrystone Quick Demo.

2. Application Highlights

- Dhrystone version 2.1
- Performs typical program tasks such as copying memory, character manipulation, and integer math
- The RX has a sophisticated DMA controller that is used to automatically refresh the LED display without requiring any processor overhead
- Results are calculated on-chip and displayed in HEW's watch window.

3. References

The user manual for the RX-Stick is: **REJ10J2168: RX-Stick User Manual**

The hardware manual for the RX610 is: **REJ09B0460: RX610 Group Hardware Manual**

The software manual for the RX610 is: **REJ09B0435: RX Family Software Manual**

Application note on Dhrystone Benchmark: **REU05B0134-0100: How to Setup and Run Dhrystone on a MCU**

3.1 Hardware Manual Relevant Chapters

Address Space – for details on the memory map of the RX

I/O Registers – provides a complete listing of all registers

Clock Generation Circuit – for details on how to setup the bus and peripheral clock on the RX

Interrupt Control Unit - for details on the enabling interrupts in the interrupt controller to the CPU or DMAC

DMA Controller (DMAC) – for information on the DMAC used to drive the LED display

I/O Ports – provides information on how to configure port pins for GPIO or peripheral use

16-Bit Timer Pulse Unit (TPU) – a number of timer channels are used to drive the display and audio playback

D/A Converter – The DAC is used to drive the speaker for audio output.

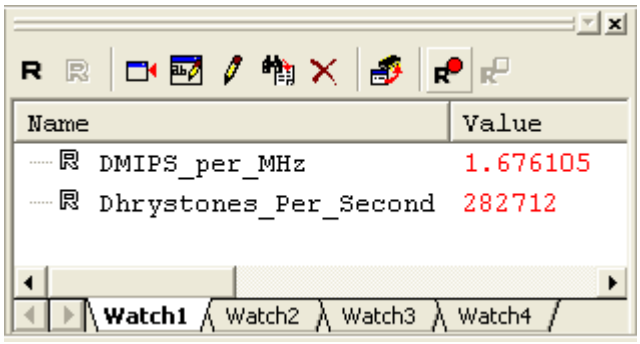
4. Application Overview

A HEW workspace is provided with the Dhrystone 2.1 benchmark code. The code runs the Dhrystone, times its own execution using on-chip peripherals, and then computes the Dhrystone performance. The HEW workspace provided is pre-configured with an open Watch Window to display the results of the benchmark.

4.1 Running the Application

Simply connect the RX-Stick to your PC, open the "RX_Stick_Dhrystone.hws" HEW workspace in "C:\Workspace\RX_Stick_Dhrystone", and select Build | Build All from the menu. The program is downloaded to the RX-Stick after the build completes and is ready for execution. Press the Reset Go button on the toolbar to run the program. After a few seconds the display changes to "OK" and the benchmark is complete. The "Halt" button can be clicked and the Dhrystone results viewed in the watch window. The user can change compiler optimization settings to see the effects on Dhrystone benchmark performance.

Figure 1- Watch Window



For accurate Dhrystone results, it is recommended that the benchmark runs with enough iterations so that at least one second of computations are needed. The RX-Stick demonstration program runs 1,000,000 iterations of the Dhrystone; this takes between 3 and 4 seconds to complete. While the test is running, the RX is using a high-resolution timer to record the execution time. At the conclusion of the benchmark, the number of Dhrystones per second and number of Dhrystone MIPS per MHz are computed. The variables that contain these results are shown in the watch window.

4.2 The Dhrystone Benchmark

The Dhrystone Benchmark is probably the most well known benchmark in the MCU industry. While it is limited in the number of MCU features it can test, it has been around for quite some time, is well understood, and provides a fairly good indication of core processing power. For a more complete discussion of the Dhrystone Benchmark and how tool chain settings affect results, please see **REU05B0134-0100: How to Setup and Run Dhrystone on a MCU**.

4.3 LED Display

The LED display is used to show the progress of the test. At start up the "RX" logo is displayed and the Dhrystone benchmark is started. The benchmark runs for a few seconds, the results are verified, and then a display of "OK" is shown to indicate the test is complete. If any errors are detected during the verification stage, a "!" is displayed.

A TPU timer channel triggers DMAC transfers from the LED screen buffer to the port pins that drive the LED's. TPU1 counts PCLK cycles at 48 MHz, and a compare match is set to fire at 2500 counts. When the match occurs, the counter is reset and a DMA transfer is initiated to update the display from the screen buffer.

It is important to note that since the DMAC runs independently of the CPU, refreshing of the LED has no impact on the Dhrystone performance. Intelligent RX peripherals like the DMAC, DTC, and ExDMAC offload the CPU from common tasks, increasing the effective speed of the chip. This speedup is not reflected in simple benchmarks like Dhrystone.

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Revision Record

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Rev.	**Date**	**Page**	**Summary**
1.0	Jan.11.2011	—	First edition issued

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The following usage notes are applicable to all MPU/MCU products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Handling of Unused Pins

   Handle unused pins in accord with the directions given under Handling of Unused Pins in the manual.

   — The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

   The state of the product is undefined at the moment when power is supplied.

   — The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.
   In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed.
   In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses

   Access to reserved addresses is prohibited.

   — The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals

   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has stabilized.

   — When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.

5. Differences between Products

   Before changing from one product to another, i.e. to a product with a different part number, confirm that the change will not lead to problems.

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