GigaDevice Semiconductor Inc.

Dhryston Porting Guide Based on GD32 MCU

Application Notes

AN164

Version 1.0

(Dec 2025)

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1. Foreword

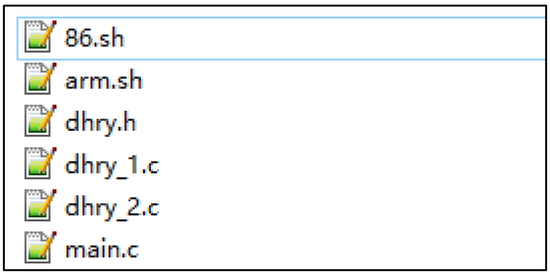
Dhrystone, one of the most common benchmark test programs, measures MCU computing capabilities. Its main purpose is to test the performance of integer operations and logical operations of MCUs.

The testing principle of Dhrystone involves measuring how many times an MCU executes the Dhrystone program within a given unit of time. The test results are expressed in DMIPS/MHz. DMIPS, short for abbreviation of Dhrystone Million Instructions Per Second, represents the number of millions of machine language instructions processed per second.

2. Dhrystone source code

The Dhrystone source code was downloaded from the Internet; we are currently testing the Version 2.1 C language version. After decompression, the source files appear as shown in ***Figure 2-1. Dhrystone source file***.

Figure 2-1. Dhrystone source file



86.sh
arm.sh
dhry.h
dhry_1.c
dhry_2.c
main.c

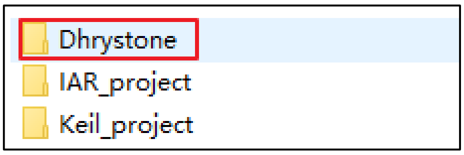
3. Dhrystone porting

3.1. Project configuration

This AN uses GD32L23x and keil5 as examples to describe Dhrystone porting and notes. Because GD32L23x is an ARM Cortex-M23 core, the files for testing Dhrystone are dhry.h, dhry_1.c, and dhry_2.c.

Create a Dhrystone folder under the project path, and copy the three files dhry.h, dhry_1.c, and dhry_2.c to this folder, as shown in ***Figure 3-1. Project directory structure*** and ***Figure 3-2. Dhrystone files***:

Figure 3-1. Project directory structure



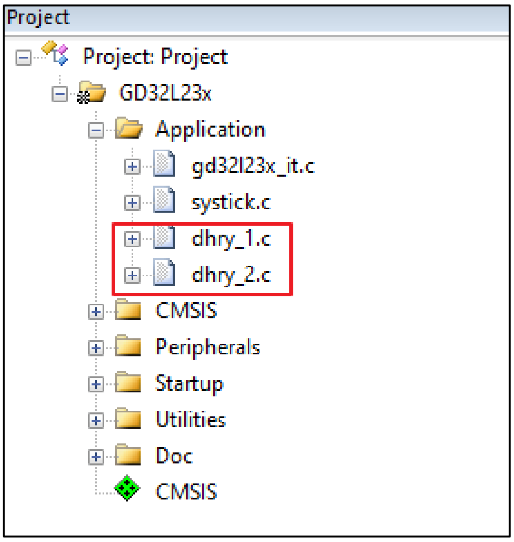
Dhrystone
IAR_project
Keil_project

Figure 3-2. Dhrystone files

dhry.h
dhry_1.c
dhry_2.c

Open the project, and add dhry_1.c and dhry_2.c to it, as shown in ***Figure 3-3. Dhrystone project structure***:

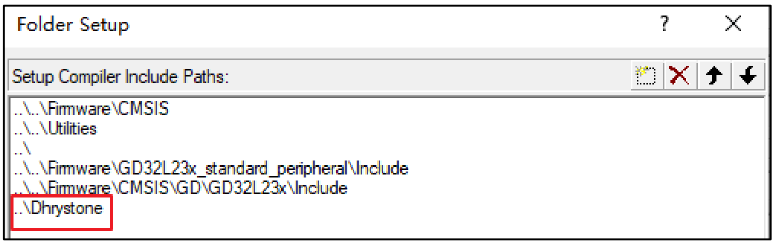
Figure 3-3. Dhrystone project structure



```
Project
⊟ Project: Project
    ⊟ GD32L23x
        ⊟ Application
            ⊞ gd32l23x_it.c
            ⊞ systick.c
            ⊞ dhry_1.c
            ⊞ dhry_2.c
        ⊞ CMSIS
        ⊞ Peripherals
        ⊞ Startup
        ⊞ Utilities
        ⊞ Doc
          CMSIS
```

Add the file inclusion path, as shown in ***Figure 3-4. Configuration of Dhrystone project file path***:

Figure 3-4. Configuration of Dhrystone project file path



```
..\..\Firmware\CMSIS
..\..\Utilities
..\
..\..\Firmware\GD32L23x_standard_peripheral\Include
..\..\Firmware\CMSIS\GD\GD32L23x\Include
..\Dhrystone
```

3.2. Code modification

The MCU requires timing and printing essential information when running the Dhrystone test code. Here, TIMER1, TIMER2, and USART1 are selected (for reference, select them as needed). Configure TIMER, USART, and the corresponding GPIO codes, as shown in ***Table 3-1. Clock configuration***, ***Table 3-2. USART and GPIO configuration***, and ***Table 3-3. TIMER configuration***:

Table 3-1. Clock configuration

```
void rcu_configuration(void)
{
    rcu_periph_clock_enable(RCU_USART1);
    rcu_periph_clock_enable(RCU_GPIOA);
    rcu_periph_clock_enable(RCU_TIMER1);
    rcu_periph_clock_enable(RCU_TIMER2);
}
```

Table 3-2. USART and GPIO configuration

```
void usart_config(void)
{
    /* connect port to USARTx_Tx */
    gpio_af_set(GPIOA, GPIO_AF_7, GPIO_PIN_2);

    /* connect port to USARTx_Rx */
    gpio_af_set(GPIOA, GPIO_AF_7, GPIO_PIN_3);

    /* configure USART Tx as alternate function push-pull */
    gpio_mode_set(GPIOA, GPIO_MODE_AF, GPIO_PUPD_PULLUP, GPIO_PIN_2);
    gpio_output_options_set(GPIOA, GPIO_OTYPE_PP, GPIO_OSPEED_10MHZ, GPIO_PIN_2);

    /* configure USART Rx as alternate function push-pull */
    gpio_mode_set(GPIOA, GPIO_MODE_AF, GPIO_PUPD_PULLUP, GPIO_PIN_3);
    gpio_output_options_set(GPIOA, GPIO_OTYPE_PP, GPIO_OSPEED_10MHZ, GPIO_PIN_3);

    /* USART configure */
    usart_deinit(USART1);
    usart_baudrate_set(USART1, 115200U);
    usart_receive_config(USART1, USART_RECEIVE_ENABLE);
    usart_transmit_config(USART1, USART_TRANSMIT_ENABLE);
    usart_enable(USART1);
}
```

Table 3-3. TIMER configuration

```
void timer_config(void)
{
    timer_parameter_struct timer_initpara;

    /* deinit TIMER */
    timer_deinit(TIMER1);
    timer_deinit(TIMER2);
    /* initialize TIMER init parameter struct */
    timer_struct_para_init(&timer_initpara);
    /* TIMER1 configuration */
    timer_initpara.prescaler          = ((clk/1000000)*2 -1);
    timer_initpara.alignedmode         = TIMER_COUNTER_EDGE;
    timer_initpara.counterdirection = TIMER_COUNTER_UP;
    timer_initpara.period              = 9999;
    timer_initpara.clockdivision      = TIMER_CKDIV_DIV1;
    timer_init(TIMER1, &timer_initpara);

    /* TIMER2 configuration */
    timer_initpara.prescaler          = 0;
    timer_initpara.alignedmode         = TIMER_COUNTER_EDGE;
    timer_initpara.counterdirection = TIMER_COUNTER_UP;
    timer_initpara.period              = 9999;
    timer_initpara.clockdivision      = TIMER_CKDIV_DIV1;
    timer_init(TIMER2, &timer_initpara);

    timer_master_slave_mode_config(TIMER1, TIMER_MASTER_SLAVE_MODE_ENABLE);
    timer_master_output_trigger_source_select(TIMER1, TIMER_TRI_OUT_SRC_UPDATE);

    timer_master_slave_mode_config(TIMER2, TIMER_MASTER_SLAVE_MODE_ENABLE);
    timer_slave_mode_select(TIMER2, TIMER_SLAVE_MODE_EXTERNAL0);
    timer_input_trigger_source_select(TIMER2, TIMER_SMCFG_TRGSEL_ITI0);

    /* enable TIMER */
    timer_enable(TIMER1);
    timer_enable(TIMER2);
}
```

The main function in the dhry_1.c file needs to be modified, as shown in ***Table 3-4. Modification of main function***:

Table 3-4. Modification of main function

```
int main (void)
/*****/

  /* main program, corresponds to procedures        */
  /* Main and Proc_0 in the Ada version             */
{
          One_Fifty       Int_1_Loc;
    REG   One_Fifty       Int_2_Loc;
          One_Fifty       Int_3_Loc;
    REG   char            Ch_Index;
          Enumeration     Enum_Loc;
          Str_30          Str_1_Loc;
          Str_30          Str_2_Loc;
    REG   int             Run_Index;
    REG   int             Number_Of_Runs;

    clk = rcu_clock_freq_get(CK_APB1);

    Next_Ptr_Glob = (Rec_Pointer) malloc (sizeof (Rec_Type));
    Ptr_Glob = (Rec_Pointer) malloc (sizeof (Rec_Type));

    Ptr_Glob->Ptr_Comp                    = Next_Ptr_Glob;
    Ptr_Glob->Discr                       = Ident_1;
    Ptr_Glob->variant.var_1.Enum_Comp     = Ident_3;
    Ptr_Glob->variant.var_1.Int_Comp      = 20;
    strcpy (Ptr_Glob->variant.var_1.Str_Comp,
          "DHRYSTONE PROGRAM, SOME STRING");
    strcpy (Str_1_Loc, "DHRYSTONE PROGRAM, 1'ST STRING");

    Arr_2_Glob [8][7] = 10;

    /* Was missing in published program. Without this statement,    */
    /* Arr_2_Glob [8][7] would have an undefined value.             */
    /* Warning: With 16-Bit processors and Number_Of_Runs > 32000,  */
    /* overflow may occur for this array element.                   */

    rcu_configuration();
    usart_config();

    printf ("Dhrystone Benchmark, Version 2.1 (Language: C)\n\r");
```

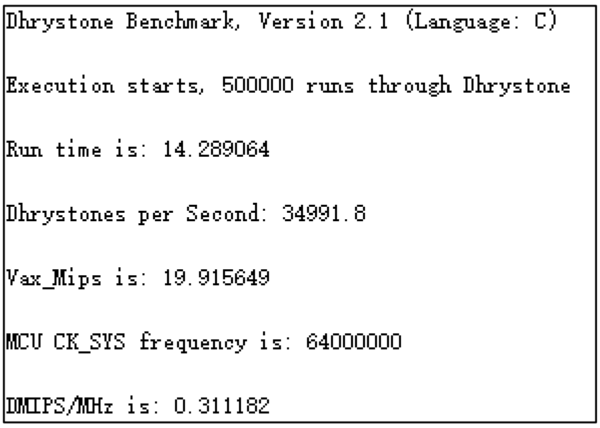
```
Number_Of_Runs = 1000000;
printf ("Execution starts, %d runs through Dhrystone\n\r", Number_Of_Runs);

timer_config();

Begin_Time = timer_counter_read(TIMER2)*10000 + timer_counter_read(TIMER1);
for (Run_Index = 1; Run_Index <= Number_Of_Runs; ++Run_Index)
{

    Proc_5();
    Proc_4();
    /* Ch_1_Glob == 'A', Ch_2_Glob == 'B', Bool_Glob == true */
    Int_1_Loc = 2;
    Int_2_Loc = 3;
    strcpy (Str_2_Loc, "DHRYSTONE PROGRAM, 2'ND STRING");
    Enum_Loc = Ident_2;
    Bool_Glob = ! Func_2 (Str_1_Loc, Str_2_Loc);
    /* Bool_Glob == 1 */
    while (Int_1_Loc < Int_2_Loc)    /* loop body executed once */
    {
        Int_3_Loc = 5 * Int_1_Loc - Int_2_Loc;
        /* Int_3_Loc == 7 */
        Proc_7 (Int_1_Loc, Int_2_Loc, &Int_3_Loc);
        /* Int_3_Loc == 7 */
        Int_1_Loc += 1;
    } /* while */
    /* Int_1_Loc == 3, Int_2_Loc == 3, Int_3_Loc == 7 */
    Proc_8 (Arr_1_Glob, Arr_2_Glob, Int_1_Loc, Int_3_Loc);
    /* Int_Glob == 5 */
    Proc_1 (Ptr_Glob);
    for (Ch_Index = 'A'; Ch_Index <= Ch_2_Glob; ++Ch_Index)
    /* loop body executed twice */
    {
        if (Enum_Loc == Func_1 (Ch_Index, 'C'))
        /* then, not executed */
        {
            Proc_6 (Ident_1, &Enum_Loc);
            strcpy (Str_2_Loc, "DHRYSTONE PROGRAM, 3'RD STRING");
            Int_2_Loc = Run_Index;
            Int_Glob = Run_Index;
        }
    }
```

```
        /* Int_1_Loc == 3, Int_2_Loc == 3, Int_3_Loc == 7 */
        Int_2_Loc = Int_2_Loc * Int_1_Loc;
        Int_1_Loc = Int_2_Loc / Int_3_Loc;
        Int_2_Loc = 7 * (Int_2_Loc - Int_3_Loc) - Int_1_Loc;
        /* Int_1_Loc == 1, Int_2_Loc == 13, Int_3_Loc == 7 */
        Proc_2 (&Int_1_Loc);
        /* Int_1_Loc == 5 */

    } /* loop "for Run_Index" */

    /**************/
    /* Stop timer */
    /**************/
    timer_disable(TIMER1);
    timer_disable(TIMER2);
    End_Time = timer_counter_read(TIMER2)*10000 + timer_counter_read(TIMER1);
    User_Time = End_Time - Begin_Time;

    Dhrystones_Per_Second = (double) Number_Of_Runs / (User_Time / 1000000);
    Vax_Mips = Dhrystones_Per_Second / 1757.0;

    printf ("Run time is: %6.6f \n\r", User_Time/1000000);
    printf ("Dhrystones per Second: %6.1f \n\r", Dhrystones_Per_Second);
    printf ("Vax_Mips is: %6.1f \n", Vax_Mips);
    printf ("\n");
    printf("MCU CK_SYS frequency is: %d\n\r%d\n\r", rcu_clock_freq_get(CK_AHB));
    printf("DMIPS/MHz is: %f \n", (double)Vax_Mips / (rcu_clock_freq_get(CK_AHB)/1000000));
    while(1);
}
```

4. Test results

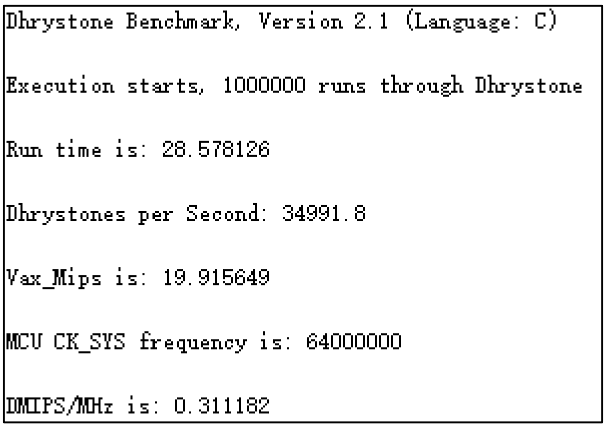
This document takes the code running in Flash as an example. Set Number_Of_Runs to 500000 and 10000000 respectively, where Dhrystones_Per_Second = number of runs/run time, Vax_Mips = Dhrystones_Per_Second/1757.0, and DMIPS/MHz = Vax_Mips/clock frequency. The corresponding test results are as shown in ***Figure 4-1. Dhrystone test 1*** and ***Figure 4-2. Dhrystone test 2***:

Figure 4-1. Dhrystone test 1



```
Dhrystone Benchmark, Version 2.1 (Language: C)

Execution starts, 500000 runs through Dhrystone

Run time is: 14.289064

Dhrystones per Second: 34991.8

Vax_Mips is: 19.915649

MCU CK_SYS frequency is: 64000000

DMIPS/MHz is: 0.311182
```

Figure 4-2. Dhrystone test 2



```
Dhrystone Benchmark, Version 2.1 (Language: C)

Execution starts, 1000000 runs through Dhrystone

Run time is: 28.578126

Dhrystones per Second: 34991.8

Vax_Mips is: 19.915649

MCU CK_SYS frequency is: 64000000

DMIPS/MHz is: 0.311182
```

5. Revision history

Table 5-1. Revision history

Revision No.	Description	Date
1.0	Initial release	Dec.05, 2025

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