32-bit microcontrollers

Data Calculation Unit **DCU of HC 32F 460** Series

Applicable objects

F Series	HC 32F460

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1   Abstract

This application note introduces the Data Computing Unit (DCU) module of HC32F460 series chip and triggers the operation by hardware event.

2   DCU Introduction

A Data Computing Unit (DCU) is a module that simply processes data without the aid of a CPU. Each DCU

The unit has 3 data registers and is capable of adding, subtracting and comparing the size of 2 data, as well as a window comparison function.

3 DCU of HC32F460 Series

3.1 Introduction

The HC32F460 series MCUs are equipped with 4 DCU units, each of which can perform its own function independently.

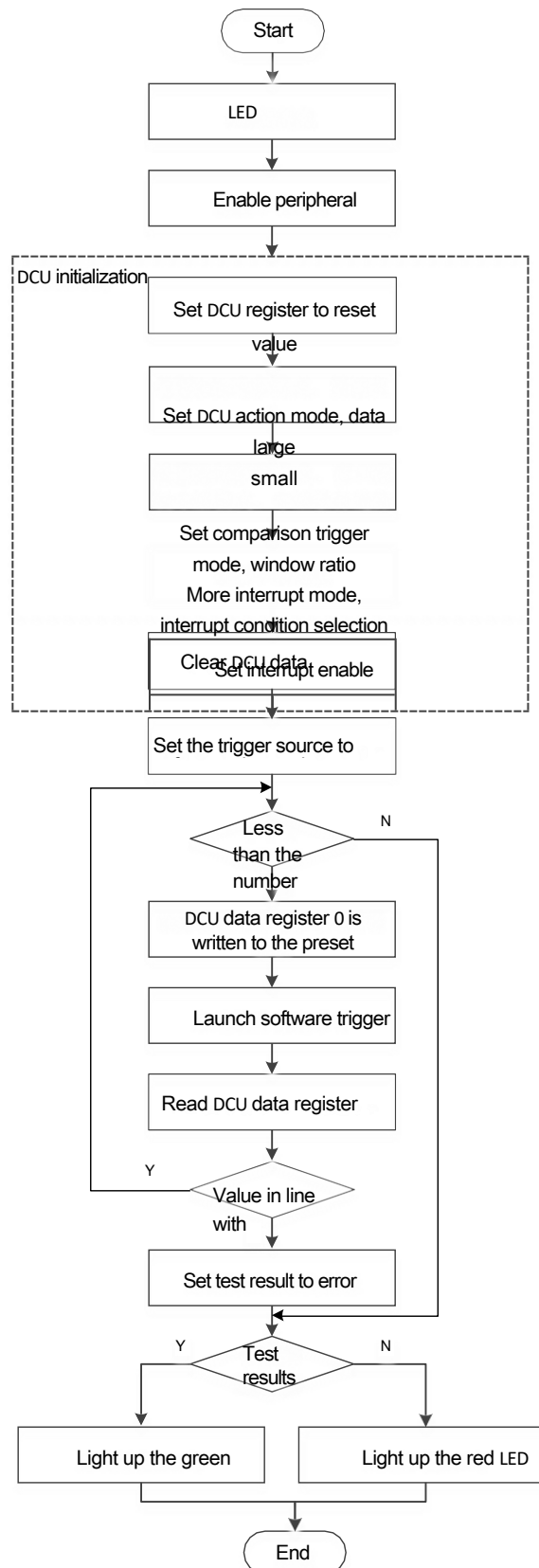## 3.2 Description

3.2.1 DCU Function

- 4 types of data processing are possible: addition of 2 data, subtraction, comparison and comparison of 3 data windows.

- The addition and subtraction operations are performed on the data in the DATA0 and DATA1 registers, and the results are stored in DATA0.

- Addition and subtraction can be computed either after writing the register or triggered by other peripheral circuit events.

- The result of addition and subtraction operations is automatically halved once, and the result of the halving operation and the result of the addition and subtraction operation are put into 2 data registers respectively for other modules.

- The comparison mode can be used for the 2
  The interrupt and flag bits can be generated when the data is greater than, less than, or equal to, respectively.

- The comparison mode can be used to compare windows, i.e., set DATA1 and DATA2 as the upper and lower limits of the window, respectively, according to
  The results of comparing DATA0 and DATA1 and DATA0 and DATA2 determine whether DATA0 is inside or outside the window.

- The event signals are used to start the peripheral circuits when other peripheral circuits with hardware trigger start function select the DCU as the trigger source.

3.2.2 Register Introduction

English description (abbreviation)	Chinese Description
DCU Control Register (DCU_CTL)	DCU control register
DCU Flag Register (DCU_FLAG)	DCU flag register
DCU Data0 Register (DCU_DATA0)	DCU data register 0
DCU Data1 Register (DCU_DATA1)	DCU data register 1
DCU Data2 Register (DCU_DATA2)	DCU data register 2
DCU Flag Clear Register (DCU_FLAGCLR)	DCU flag reset register
DCU Interrupt Select Register (DCU_INTSEL)	DCU interrupt condition selection register
DCU Trigger Select Register (DCU_TRGSEL)	DCU Trigger Source Selection Register

3.2.3 Workflow Introduction

This section describes the workflow of the sample dcu_hw_trigger_add used in this AN.

```
                    ( Start )
                        │
                        ▼
                  ┌──────────┐
                  │   LED    │
                  └──────────┘
                        │
                        ▼
                ┌────────────────┐
                │ Enable peripheral │
                └────────────────┘
                        │
  ┌─────────────────────────────────────────┐
  │ DCU initialization                       │
  │        ┌────────────────────┐            │
  │        │ Set DCU register to reset │      │
  │        │ value              │            │
  │        └────────────────────┘            │
  │        ┌────────────────────┐            │
  │        │ Set DCU action mode, data │      │
  │        │ large              │            │
  │        │ small              │            │
  │        └────────────────────┘            │
  │        Set comparison trigger            │
  │        mode, window ratio                │
  │        More interrupt mode,              │
  │        interrupt condition selection     │
  │        ┌────────────────────┐            │
  │        │ Clear DCU data     │            │
  │        │ Set interrupt enable │          │
  │        └────────────────────┘            │
  └─────────────────────────────────────────┘
                        │
                        ▼
                ┌────────────────────┐
                │ Set the trigger source to │
                └────────────────────┘
                        │
                        ▼
                   ◇ Less ◇          N
                   ◇ than the ◇ ─────────┐
                   ◇ number ◇            │
                        │ (implied)       │
                        ▼                 │
                ┌────────────────────┐    │
                │ DCU data register 0 is │ │
                │ written to the preset │  │
                └────────────────────┘    │
                        │                 │
                        ▼                 │
                ┌────────────────────┐    │
                │ Launch software trigger │ │
                └────────────────────┘    │
                        │                 │
                        ▼                 │
                ┌────────────────────┐    │
                │ Read DCU data register │ │
                └────────────────────┘    │
                        │                 │
             Y          ▼                 │
        ┌──────── ◇ Value in line ◇       │
        │         ◇ with ◇                │
        │              │                  │
        │              ▼                  │
        │       ┌────────────────────┐    │
        │       │ Set test result to error │ │
        │       └────────────────────┘    │
        │              │                  │
        │              ▼ ◄────────────────┘
     Y  ◇ Test ◇  N
   ┌────◇ results ◇────┐
   │                   │
   ▼                   ▼
┌──────────────┐  ┌──────────────┐
│ Light up the green │ │ Light up the red LED │
└──────────────┘  └──────────────┘
        │               │
        └───────┬───────┘
                ▼
             ( End )
```

4 Sample Code

4.1 Code Introduction

Users can write their own code to learn and verify the module according to the above workflow, or download the sample code of Device Driver Library (DDL) directly through the website of UW Semiconductors and use the sample of DCU to verify.

The following section briefly describes the configuration involved in this sample DDL-based DCU module dcu_hw_trigger_add code for AN.

1) Initializing LEDs:

```
/* Initialize LED */
LedInit().
```

2) Enables the peripheral clock:

```
/* Enable peripheral clock */
PWC_Fcg0PeriphClockCmd(PWC_FCG0_PERIPH_PTDIS |
PWC_FCG0_PERIPH_DCU1, Enable).
```

3) Initialize DCU:

```
/* Initialize DCU */
MEM_ZERO_STRUCT(stcDcuInit);
stcDcuInit.u32IntSel = 0;
stcDcuInit.enIntWinMod e = DcuIntInvalid;
stcDcuInit.enDataSize = DcuDataBit16;
stcDcuInit.enOperation = DcuHwTrigOpAdd;
DCU_Init(DCU_UNIT, &stcDcuInit).
DCU_WriteDataHalfWord(DCU_UNIT, DcuRegisterData0, 0x0000);
DCU_SetTriggerSrc(DCU_UNIT, EVT_TRIG_NUM).
```

4) Start DCU peripheral trigger operation:

```
for (i = 0; i < u8CalTimes; i++)
{
   DCU_WriteDataHalfWord(DCU_UNIT, DcuRegisterData1, m_au16Data1Val[i]).

   /* Start soft trigger event */
   AOS_SW_Trigger().

   m_au16Data0Val[i] = DCU_ReadDataHalfWord(DCU_UNIT, DcuRegisterData0);
   m_au16Data2Val[i] = DCU_ReadDataHalfWord(DCU_UNIT, DcuRegisterData2 ).
```

```
/* Compare DCU regisger DATA0 && DATA2 value: DATA0 value == 2 * DATA2 value
*/
  if (m_au16Data0Val[i] ! = (2 * m_au16Data2Val[i]))
  {
    enTestResult = Error;
    break.
  }
  else
  {
  }
}
```

4.2 Code Run

The sample code of HC32F460 DDL can be downloaded from the website of UW Semiconductors.

(dcu_hw_trigger_add), and run the code with the evaluation board (EV-HC32F460-LQFP100-050-V1.1) to learn to use the DCU module.

The following section describes how to run the DCU sample code on the evaluation board and observe the results:

— Verify that the correct IAR EWARM v7.7 tool is installed (please download the appropriate installation package from the official IAR website and refer to the user manual for installation).

— Download the HC32F460 DDL code from the UW Semiconductors website.

— Download and run the project file in dcu\dcu_hw_trigger_add\ at

1) Open the dcu_hw_trigger_add\ project and open the 'main.c' view as follows:
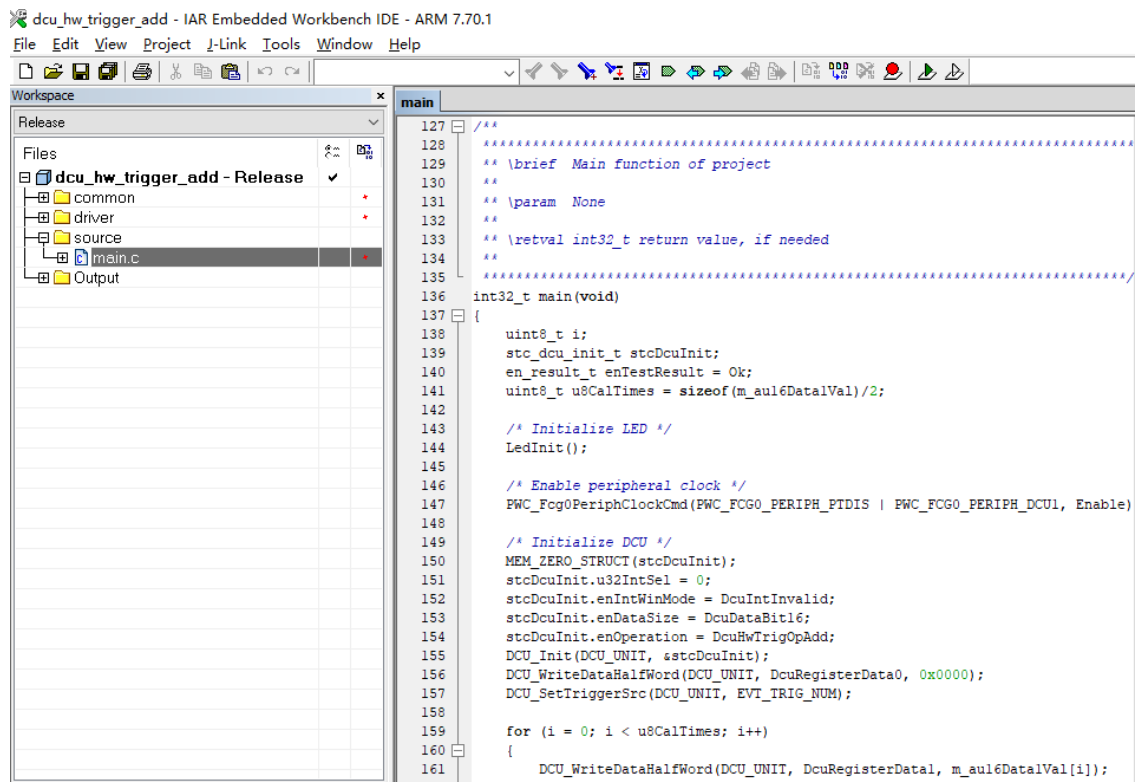
2) Click to recompile the entire project.

3) Click Download the code to the evaluation board and run it at full speed.

4) The green LED lights up.

5 Summary

The above section briefly introduces the DCU of HC32F460 series, explains the registers and part of the operation flow of the DCU module, and demonstrates how to use the DCU sample code, so that users can configure and use the DCU module according to their needs in actual development.

6 Version Information & Contact

Date	Versions	Modify records
2019/3/15	Rev1.0	Initial Release
2020/8/26	Rev1.1	Update supported models

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