UART to DALI Gateway

Example Code Introduction for 32-bit NuMicro® Family

Document Information

Application	This example code uses M467 to perform UART to DALI gateway, including address search, scene configuration, grouping, and dimming functions on DALI lighting devices.
BSP Version	M467_Series_BSP_CMSIS_V3.00.002
Hardware	NuMaker-M467HJ V1.0

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1. Overview

This example code uses M467 to perform UART to DALI gateway, including address search, scene configuration, grouping, and dimming functions on DALI lighting devices.

1.1 Principle

According to the IEC-62386 standard, a DALI gateway can connect up to 64 lighting devices, corresponding to short addresses of 0-63. Each DALI lighting device has a unique 24-bit random address. The DALI gateway obtains the 24-bit random address of the device through compare commands, and then allocates short addresses of 0-63 in ascending order of random addresses. The system framework is shown in Figure 1-1.

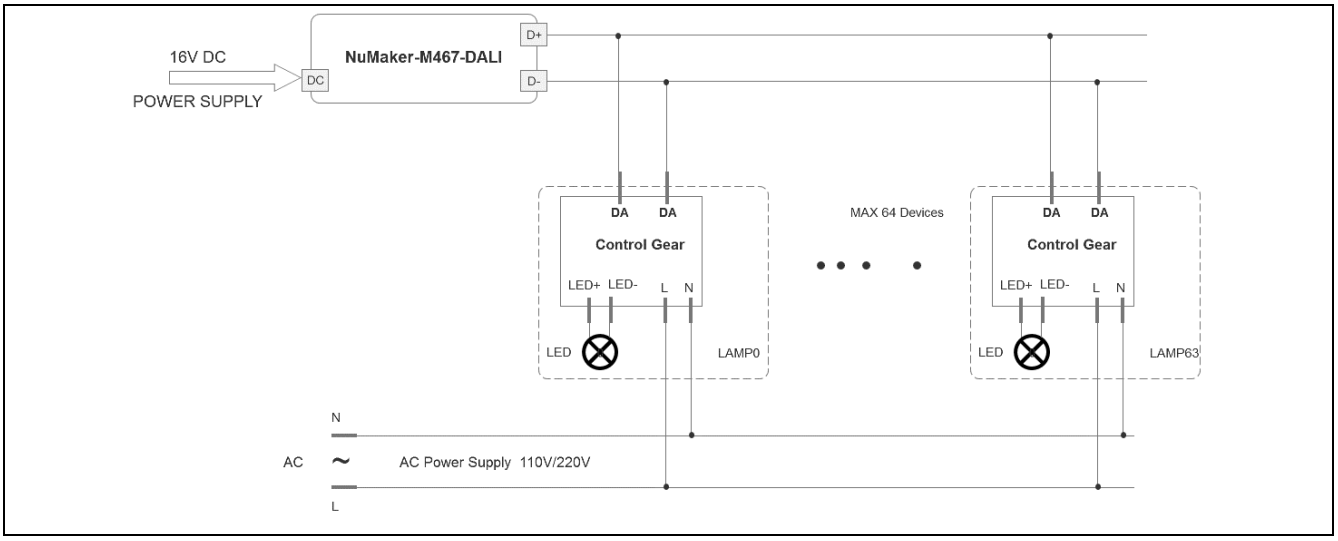


Figure 1-1 UART to DALI Gateway System Block Diagram

This example code uses the evaluation board NuMaker-M467HJ-V1.0 and the DALI extension board NuMaker-DALI-HID_V1.0 to implement DALI functionality.

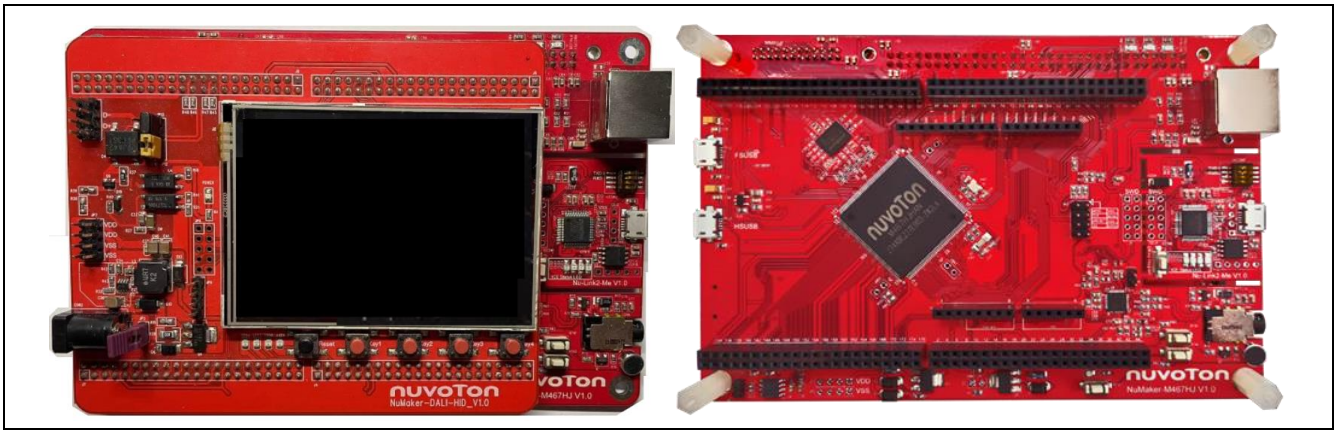


Figure 1-2 M467 DALI NuMaker Board

During user testing, DALI2 power supply and lighting devices need to be connected. Of course, the DALI slave device evaluation board DALI_SLAVE-MII57_V1 can also be used here to

simulate DALI2 power lighting testing as shown in Figure 1-3. Note that to obtain the DALI slave evaluation board and corresponding information, it is necessary to sign a confidentiality agreement.

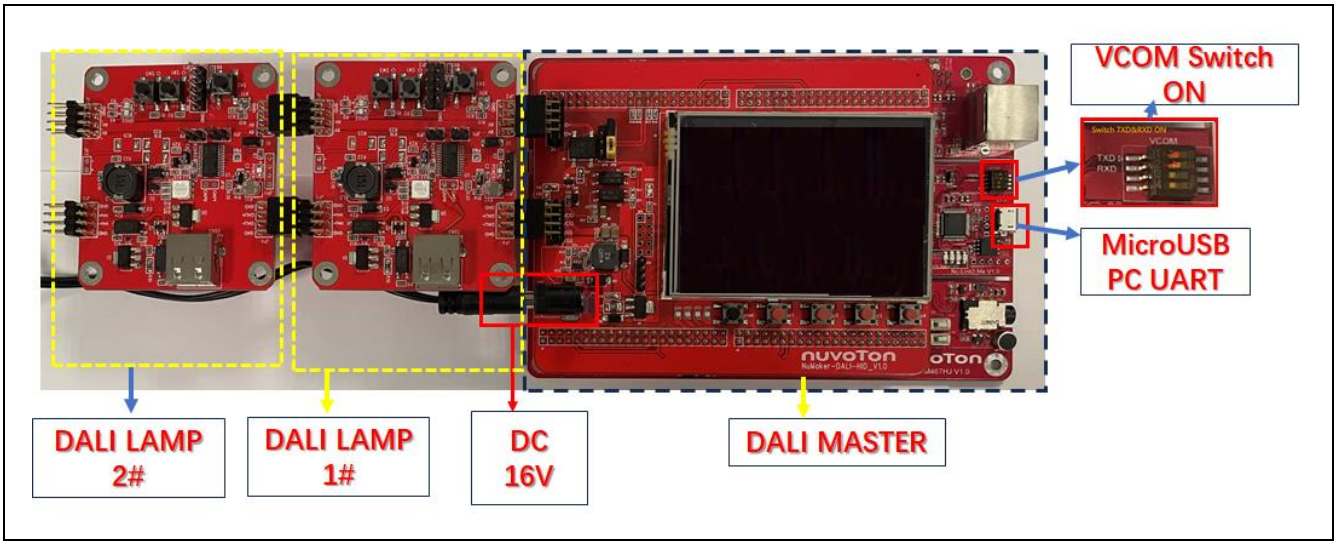


Figure 1-3 Nuvoton DALI Gateway Connected to Slave Simulation Test

This example provides users with the M467 UART to control the lighting devices on the DALI bus while four buttons are also provided for quick control of DALI devices. The control function block diagram is as follows.

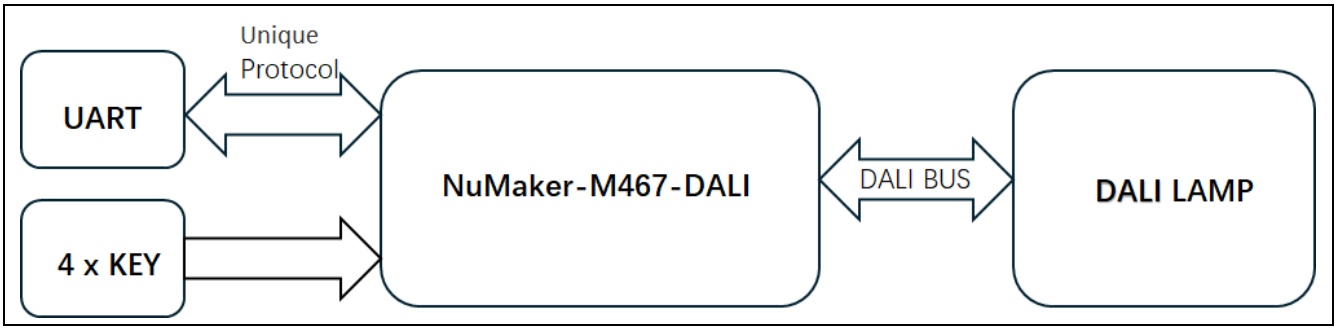


Figure 1-4 Control Function Block Diagram

Figure 1-4 shows that the example uses four buttons, Key1, Key2, Key3, and Key4, which correspond to functions such as address new search, address extension search, address scan search, and all light on/off. The functions are introduced in the following three points:

- The newly address search function allows the gateway to connect to a DALI device system without any assigned address. It obtains the random address of the device through binary division and then assign the value of the short address 0-63 in descending order based on the random address value.
- The extension address search function is generally used when, after a new address search, the DALI system connects a new device with an unassigned address. At this time, the device with an assigned short address does not need to be reassigned. The extension search can only be used to allocate an address to the newly access device. Similarly, the binary method is used to obtain the random address of the new access

device, and then the value of the short address is allocated in descending order based on the random address value (starting from the maximum short address of the existing device until the short address reaches the value of 63).

- The address scan search function refers to the gateway accessing a system that has already been assigned DALI device addresses, and only needs to search for all existing addresses of the devices through address scanning, without the need for DALI address allocation.

In Figure 1-4, it can be seen that users not only can control device functions through button operations but also control DALI lighting devices through UART. The serial port protocol is defined in Table 1-1, and users can expand it according to actual applications.

Head	Command	Level	End	Command Interpretation
@DALI_	SEARCH_ADDR		Enter key	Address search
	Dim_	0~100		Dim level 0-100%
	SetScene0_	0~100		Set Scene0 level 0-100%
	GoToScene0			Go to Scene0
	SetGroup0			Set Group0
	Group0_	0~100		Group0 dim level 0-100%

Table 1-1 UART to DALI Broadcast Protocol

The DALI commands converted in the above table are mainly broadcast commands. For multi device systems, address operations are required. Here, an address command operation is performed for the DAPC dimming command. The UART command is shown in Table 1-2.

Head	Command	Address	Level	End	Command Interpretation
@DALI_	Dim _	A00_	0~100	Enter key	Dimming level 0-100% for the addressed 0 device

Table 1-2 UART to DALI Addressed Protocol

Modify the range of values from 0 to 63 for the address symbol A00 to dim the corresponding short address. Users can also extend other dimming commands in a similar format.

1.2 Demo Result

After compilation, start the ICP Programming Tool for programming. Under Keil directory, select the file *M467_UART_To_DALI_Gateway.bin* for APROM. The configuration options are shown in Figure 1-5.

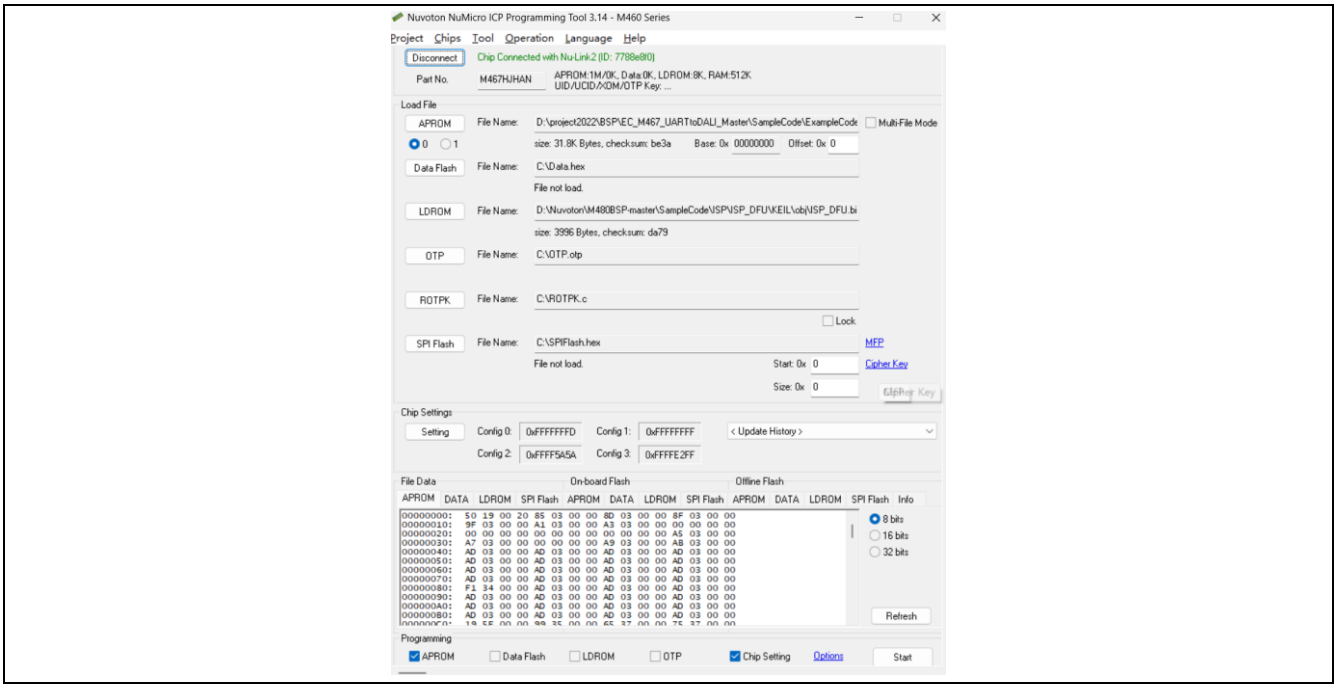


Figure 1-5 ICP Tool Window

The chip configuration is shown in Figure 1-6.

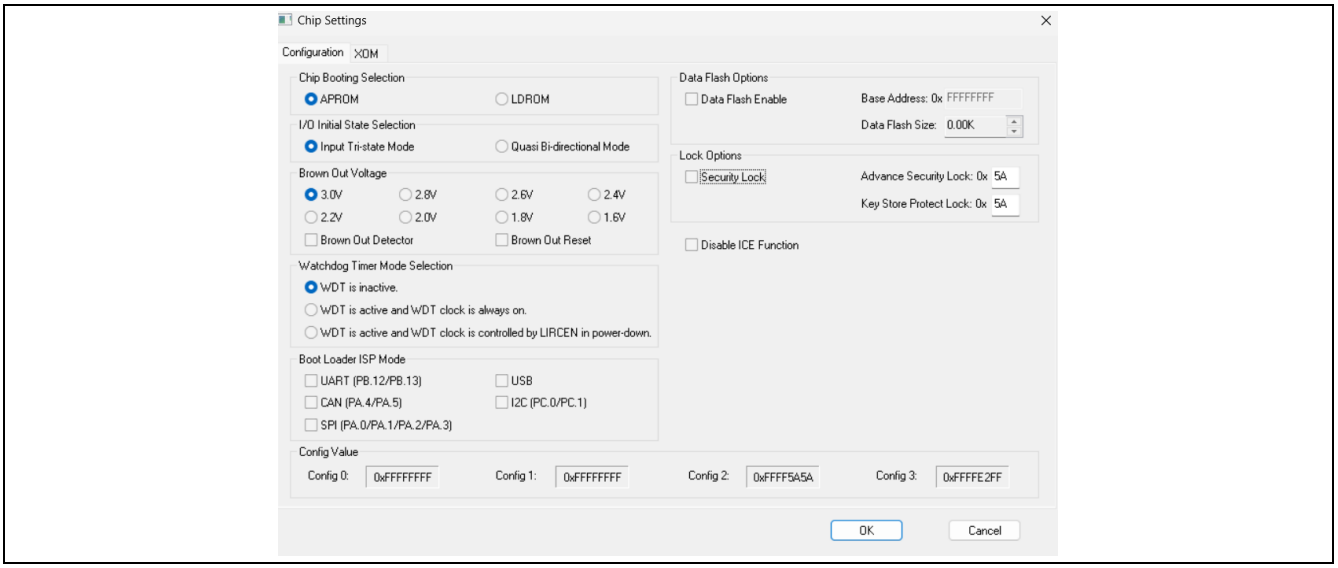


Figure 1-6 Chip Settings

When the sample code runs, the execution result will be printed by PC UART, and the program will perform a brand-new address searching at the beginning. The information will be printed as follows.

```
DALI Device Addressing New...
No DALI Device connected...
```

Connect a DALI lighting device and press the Key1 button to search for the DALI light in a new address searching mode. By printing the information below, it can be seen that the search is successful and a device has been found.

```
DALI Device Addressing New...
DALI_Addressing new task done!
DALI2_DEVICES NUM = 1
```

Connect another DALI lighting device and press the Key2 button to the externed search mode. By printing the information below, it can be seen that the search is successful and a new device has been found.

```
DALI Device Addressing Extension...
DALI_AddressingExtension task done!
DALI2_DEVICES Extension NUM = 1
```

Pressing the Key3 button can search for DALI lights with the existed search mode. By printing the information below, it can be seen that the search is successful and two devices have been allocated.

```
DALI Device Addressing Existing...
DALI_AddressingExisting task done!
DALI2_DEVICES NUM = 2
```

Press the Key4 to see that all lights are turned off. By printing the information below, it can be seen that the light off command has been issued.

```
Light Off...
```

Press the Key4 again to see that all lights are turned on. By printing the information below, you can see that the light on command has been issued.

```
Light On...
```

The above tests the functions of four buttons. Now let's start testing the UART command. Here, enter the test broadcast command for light off and print the message as follows:

```
@DALI_Dim_0
```

It can be seen that two lights have been turned off. Enter the test addressing command for light on again and print the message as follows:

```
@DALI_Dim_A00_100
```

It can be seen that the light with the short address 0 is turned on, and the other light remain off.

2. Code Description

Both key task and serial communication task are processed in the main function, which converts key down or UART commands into DALI control logic. The code is located in *main.c*.

```
/*****************************************************************************//**
 * @file     main.c
 * @version  V3.00
 * @brief    M460 UART to DALI Gateway .
 *
 * @copyright SPDX-License-Identifier: Apache-2.0
 * @copyright Copyright (C) 2024 Nuvoton Technology Corp. All rights reserved.
*****************************************************************************/
    ……
int main(void)
{
    volatile uint8_t addr;
    SYS_Init();
    UART_Init();/* Init UART for printf */
    Board_Init();
    NVIC_EnableIRQ(UART0_IRQn);
    UART_EnableInt(UART0, (UART_INTEN_RDAIEN_Msk));
    DALI_Init();/* Init DALI bus */
    MainTask(); /* At frist, start new address searching */

    while (1)
    {
       if(bUartDataReady_DALI) /*UART receive data process for DALI control*/
       {
           bUartDataReady_DALI = 0;
           ParseCommand_DALI();
        }
//================= button ======================
        if(KEY1_status == 0) /* New address search */
        {
           printf("DALI Device Addressing New...\r\n");
           DALI_AddressingNew();
           KEY1_status = 1;
        }
        else if(KEY2_status == 0) /* extend address search*/
        {
            printf("DALI Device Addressing Extension...\r\n");
            DALI_AddressingExtension();
            KEY2_status = 1;
        }
        else if(KEY3_status == 0) /* Read existing devices*/
        {
            printf("DALI Device Addressing Existing...\r\n");
            DALI_AddressingExisting();
            KEY3_status = 1;
        }
        else if(KEY4_status == 0) /* Light On/Off*/
        {
            if(F_dimming)
              {
```

```
                F_dimming=0;
                g_parameter.send_data[CMD] = (0xFEFE); /*Light ON */
                setSendSetting(CMD, 16, 0, 0, 0);
                test_F = 1;
                while(test_F != 0){}
                printf("Light On...\r\n");
            }
            else
            {
                F_dimming=1;
                g_parameter.send_data[CMD] = (0xFE00); /*Light OFF*/
                setSendSetting(CMD, 16, 0, 0, 0);
                test_F = 1;
                while(test_F != 0){}
                printf("Light Off...\r\n");
            }
            KEY4_status = 1;
        }
//============================================
    }
}
```

3. Software and Hardware Requirements

3.1 Software Requirements

- BSP version
  - M460_Series_BSP_CMSIS_V3.00.002
- IDE version
  - Keil uVersion 5.28

3.2 Hardware Requirements

- Circuit components
  - NuMaker-M467HJ V1.0
  - NuMaker-DALI-HID_V1.0
- Pin Connect
  - Connect the +16v circular hole DC source to the COM2 of the NuMaker-DALI-HID_V1.0 board to support power supply of the board and DALI bus.
  - Connect D+ D- to the DALI interface of the DALI lighting device.
  - Connect the NuMaker-M467HJ V1.0 board and the PC USB via a micro-USB cable, turn on the TX/RX switch of VCOM, and use a serial port tool to display the execution result of the sample code.

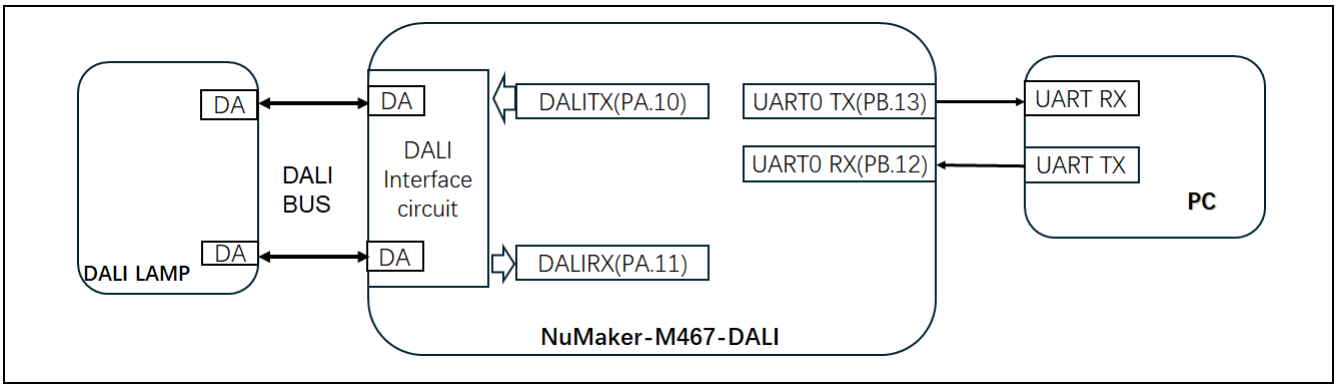


Figure 3-1 Pin Connect

4. Directory Information

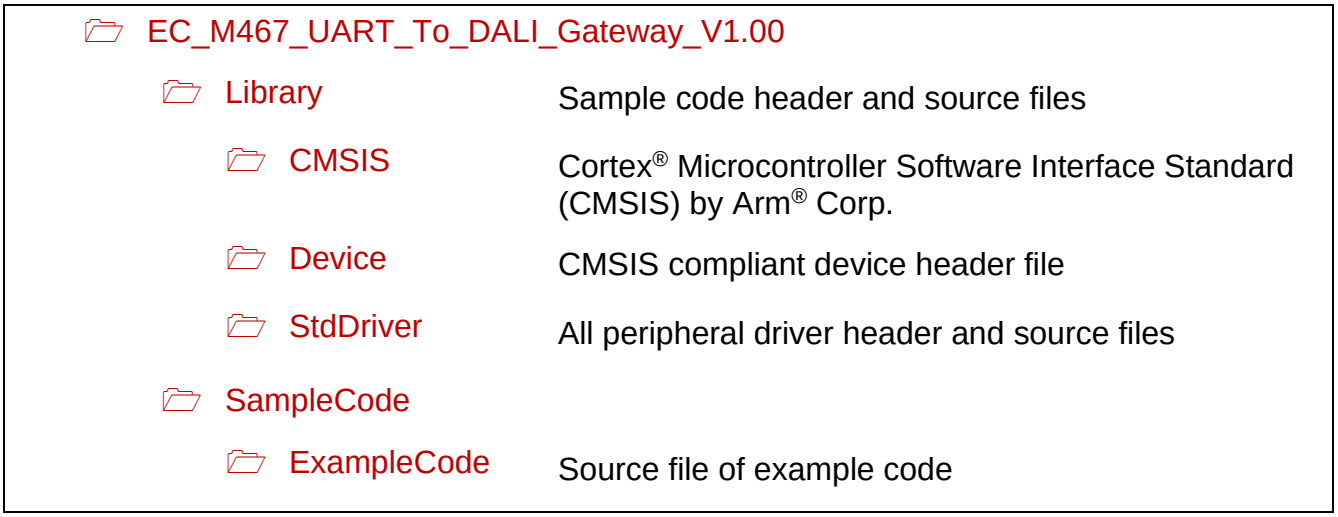


Figure 4-1 Directory Structure

5. Example Code Execution

1. Browse the sample code folder as described in the Directory Information section and double-click *M467_UART_To_DALI_Gateway.uvprojx*.
2. Enter Keil compile mode.
   - Build
   - Download
   - Start/Stop debug session
3. Enter debug mode.
   - Run

6. Revision History

Date	Revision	Description
2024.05.10	1.00	Initial version.

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