RL78/G23

Unique ID Read Driver

Introduction

Each RL78/G2x chip is programmed with a unique ID. The unique ID can be used to prevent unauthorized use of software IP and is useful for managing products individually.

This application note presents unique ID usage examples and describes how to use the unique ID read driver. The driver reads the 16-byte unique ID and 9-byte product name stored as ASCII code in the extra area and writes them to a specified area.

Target Device

RL78/G23

When using this application note with other Renesas MCUs, careful evaluation is recommended after making modifications to comply with the alternate MCU.

Contents

1. Overview

1.1 About This Application Note

This application note presents unique ID usage examples and describes how to use the unique ID read driver.

1.2 Confirmed Operation Environment

The operation of the sample code accompanying this application note has been confirmed under the conditions listed below.

Table 1.1 Confirmed Operation Environment

Item	Description
MCU used	RL78/G23 (R7F100GLG2D)
Operating frequencies	• High-speed on-chip oscillator clock: 32 MHz • CPU/peripheral hardware clock: 32 MHz
Operating voltage	• 3.3 V • LVD0 operation (V_{LVD0}): Reset mode Rise (typ.): 1.670 V Fall (typ.): 1.630 V
Integrated development environment (CS+)	Renesas Electronics CS+ for CC V8.05.00
C compiler (CS+)	Renesas Electronics CC-RL V1.10
Integrated development environment (e^2 studio)	Renesas Electronics e^2 studio 2021-04
C compiler (e^2 studio)	Renesas Electronics CC-RL V1.10
Integrated development environment (IAR)	IAR Systems IAR Embedded Workbench for Renesas RL78 V4.21.1
C compiler (IAR)	
Smart configurator	V.1.0.0
Board support package (r_bsp)	V.1.00
Emulator	E2 emulator Lite
Board used	RL78/G23-64p Fast Prototyping Board (RTK7RLG230CLG000BJ)

Table 1.2 Smart Configurator Settings

Item	Description
Clock	f_{IHP}:32 MHz f_{CLK}: 32,000 kHz (high-speed on-chip oscillator clock) f_{SXL}: 32.768 kHz (low-speed on-chip oscillator clock)
UART0	Component: UART communication Operating mode: Transmission Resource: UART0 Operating clock: CK00 Clock source: f_{CLK}/2 Transfer mode: Single transfer mode Number of data bits: 8 Data transfer report: LSB Parity: No parity Stop bits: 1 Transmit data level: Non-inverted (normal) Transfer rate: 115,200 (bps) Interrupts: Level 3 (low priority) Callback function: Transmit end

Table 1.3 Option Byte Settings

Address	Setting Value	Description
000C0H/040C0H	1110 1111B (EFH)	Watchdog timer operation stop (after reset or count stop)
000C1H/040C1H	1111 1111B (FFH)	LVD0 reset mode Detection voltage: Rise 1.670 V, fall 1.630 V
000C2H/040C2H	1110 1000B (E8H)	Flash operating mode: High-speed main mode High-speed on-chip oscillator frequency: 32 MHz
000C3H/040C3H	1000 0100B (84H)	On-chip debugging operation enabled

2. About the Unique ID

2.1 Unique ID Specifications

For detailed information on the unique ID, refer to Chapter 28, Security Functions, in the following manual.

RL78 Family User's Manual: Software (R01US0015E)

2.2 Unique ID Usage Examples

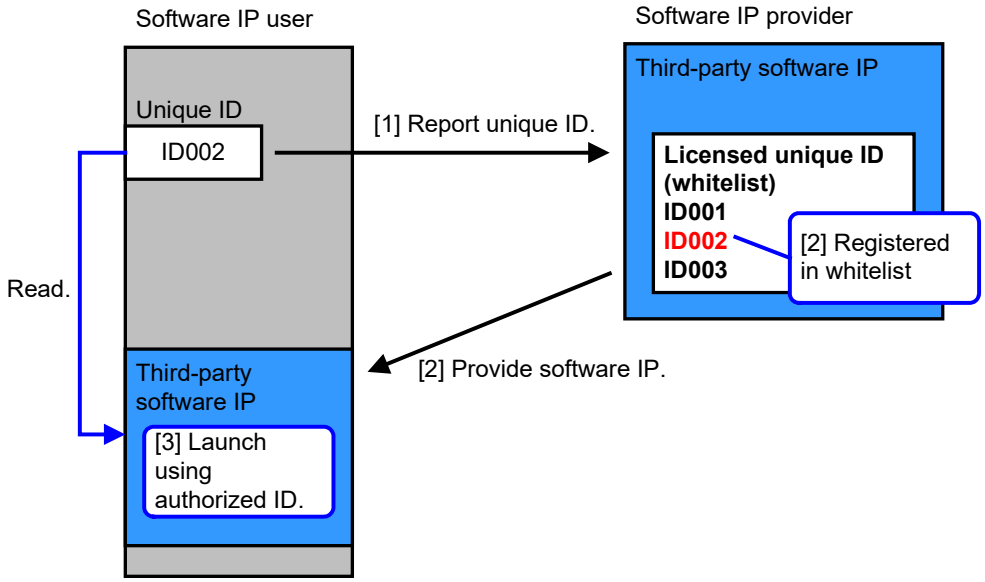
The RL78/G23 does not have a Trusted Secure IP module*1 like that incorporated into RX and RZ Family MCUs. Nevertheless, the unique ID can be used to implement security and product management as described below.

Note: 1. A secure hardware IP module exclusive to Renesas. It forms a hardware security layer that cannot be breached by external attacks and comprises logic circuits that allow secure utilization of an encryption engine and encryption keys.

2.2.1 Preventing Piracy

By registering specific unique IDs within a software program, it is possible to limit the individuals who can run it.

In cases where the software license is dependent on the number of copies of the product, it is possible to maintain a list of licensed unique IDs within the software and thereby ensure that it can only be run on user products with licensed unique IDs.



2.2.2 Pseudorandom Number Seed

A unique ID can be used as a seed for generating pseudorandom numbers. Since the pseudorandom numbers that can be generated using the unique ID as the seed are fixed, values such as "unique ID + timestamp" can be used instead.

The pseudorandom numbers generated in this fashion can then be used as encryption keys, for challenge-response authentication, and so on.

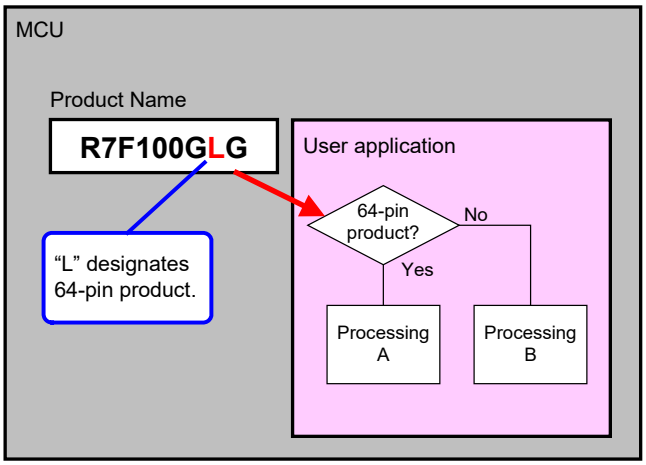
2.2.3 Management of Shipped Products

If the user keeps a list of the unique IDs associated with finished products when they ship, it becomes possible to establish links between the unique ID, production lot information, and shipping destination of each product. This can be used for product management, making it possible for example to inform customers that there is a risk that they may have received detective products if a production defect affecting a specific production lot occurs.

2.2.4 Program Branching by Product Name

The product name includes information designating the pin count and flash memory size.

It is possible to branch dynamically to different processing based on the product number (pin count). (For example, the port numbers may differ even though the same functions are used.) This makes it possible for a single program to support MCUs with different pin counts.



3. Related Application Notes

Application notes related to this application note are listed below. Consult them in conjunction with this document.

Third-Party Program Protection Application Note (R20AN0616EJ)

4. Software Configuration

4.1 File Structure

The unique ID read driver files are under libsrc in the file structure shown in Table 4.1 and Figure 4.1. Table 4.1 lists the role of each file. The relevant portion of the file structure is enclosed in the red box in Figure 4.1.

Table 4.1 Roles of Unique ID Read Driver Files

File Name	Description
r_uniq_if.h	This is the header file of the unique ID read driver. It contains macro, type, and prototype declarations that can be referenced by the user. This file must be included in your project in order to use the unique ID read driver.
r_uniq_api.c	This is the source file of the unique ID read driver. You must build this file in order to use the unique ID read driver.

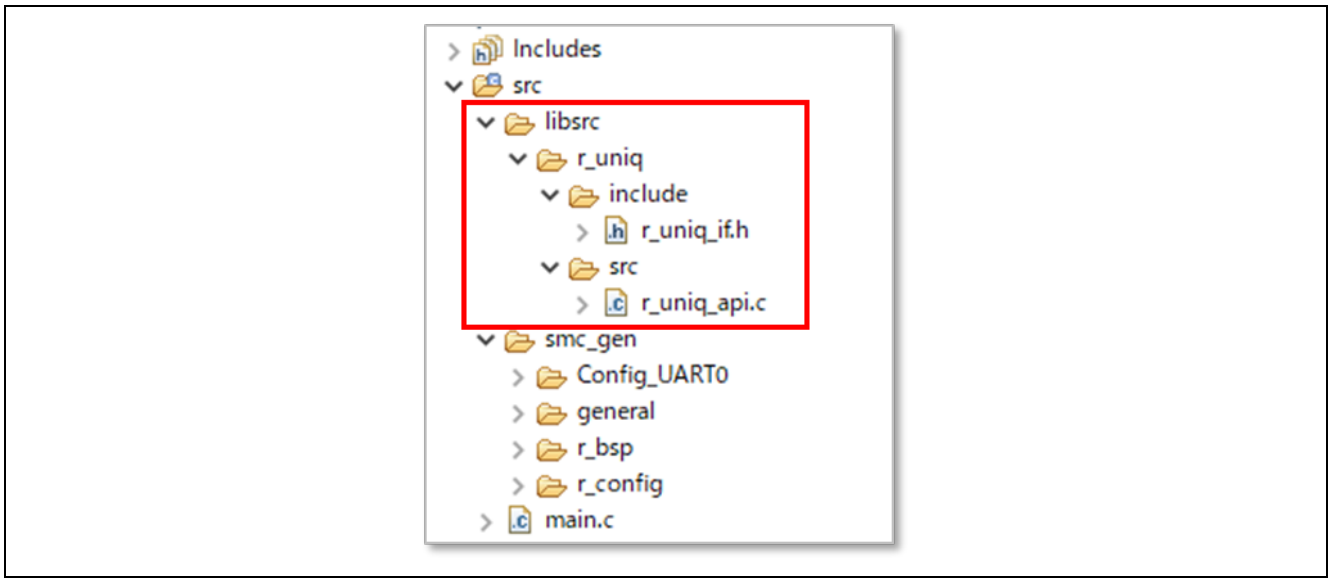


Figure 4.1 Driver File Structure in Distribution Package

5. Data Configuration

5.1 Constants

Table 5.1 lists the constants used by the unique ID read driver. These constants are defined in the r_uniq_if.h file.

Table 5.1 Constants Used by Unique ID Read Driver

Constant Name	Setting Value	Description	File
UNIQ_CFG_PRV_UNIQID_SIZE	16	Byte count of unique ID	r_uniq_if.h
UNIQ_CFG_PRV_PDCT_SIZE	9	Byte count of product name ASCII code	r_uniq_if.h

5.2 Enumerated Types

5.2.1 End Status of Read Function

Table 5.2 End Status of Read Function

```
typedef enum
{
    UID_SUCCESS = 0, /* Read successful */
    UID_ERR_FAILURE /* Read failure */
} e_uniqid_err_t;
```

5.3 Structures

5.3.1 Unique ID Information

The unique ID is stored in this structure.

Table 5.3 Structure for Storing Unique ID

```
typedef struct
{
    uint8_t uniq_id[UNIQ_CFG_PRV_UNIQID_SIZE];
} st_uniq_id_t;
```

5.3.2 Product Name ASCII Code Information

The product name ASCII code is stored in this structure.

Table 5.4 Structure for Product Name ASCII Code

```
typedef struct
{
    uint8_t product_name[UNIQ_CFG_PRV_PDCT_SIZE];
} st_pdct_t;
```

6. API Functions

Table 6.1 lists the functions of the unique ID read driver.

Table 6.1 Functions

Function Name	Description	Source File
R_UID_Read	Processing to read the unique ID	r_uniq_api.c
R_PDCT_Read	Processing to read the product name ASCII code	r_uniq_api.c

6.1 R_UID_Read Function

Table 6.2 R_UID_Read Function Specifications

Format	e_uniqid_err_t R_UID_Read (st_uniq_id_t *pdest_addr)
Description	Performs processing to read the unique ID.
Parameters	pdest_addr Pointer to the structure for storing the unique ID
Return Values	UID_SUCCESS : Unique ID read normal end
Special Notes	—

6.2 R_PDCT_Read Function

Table 6.3 R_PDCT_Read Function Specifications

Format	e_uniqid_err_t R_PDCT_Read (st_pdct_t *pdest_addr)
Description	Performs processing to read the product name ASCII code.
Parameters	pdest_addr Pointer to the structure for storing the product name ASCII code
Return Values	UID_SUCCESS : Unique ID read normal end
Special Notes	—

7. Sample Project

This sample project is a software program that uses the unique ID read driver to read the unique ID and the product name in ASCII code and then displays them in a terminal emulation application.

The program uses UART0 interfaced to a micro USB port.

A PC with a terminal emulation application running on it is necessary for output.

Table 7.1 Device Configuration

No.	Device	Description
1	Development PC	The PC used for development.
2	Evaluation board (RL78/G23 Fast Prototyping Board)	—
3	Host PC Serial communication software supporting the XMODEM/SUM transfer protocol	The development PC can also be used for this purpose.
4	USB cable (mini-B type)	Provides a USB connection between the evaluation board and host PC.

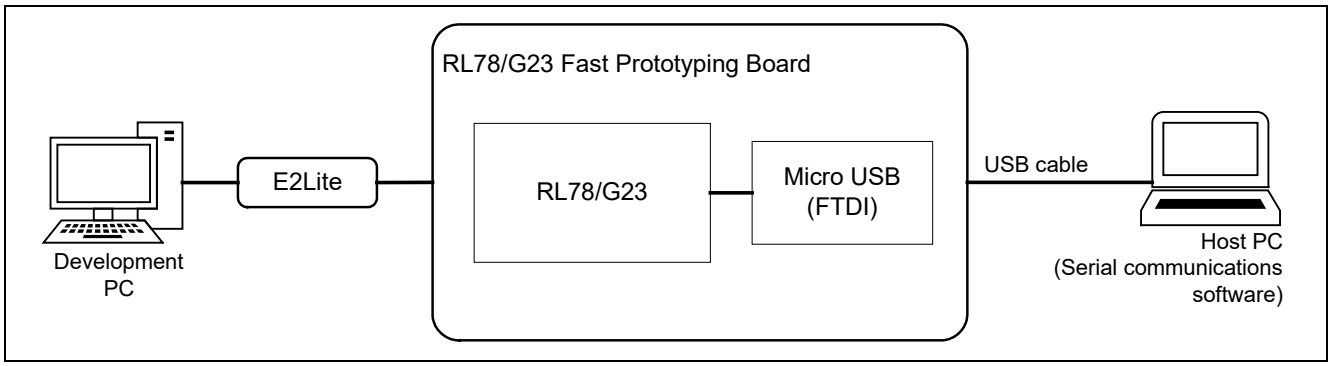


Figure 7.1 RL78/G23 Fast Prototyping Board Device Connection Diagram

Table 7.2 Communication Specifications

Item	Description
Communication system	Asynchronous communication
Bit rate	115,200 bps
Data length	8 bits
Parity	None
Stop bit	1 bit
Flow control	None

7.1 Processing Sequence of Sample Project

The following is an outline of the processing of the sample code.

(1) Start operation of UART0.
(2) Read unique ID.
(3) Read product name ASCII code.
(4) Display unique ID using printf() (send to terminal).
(5) Display product name ASCII code using printf() (send to terminal).

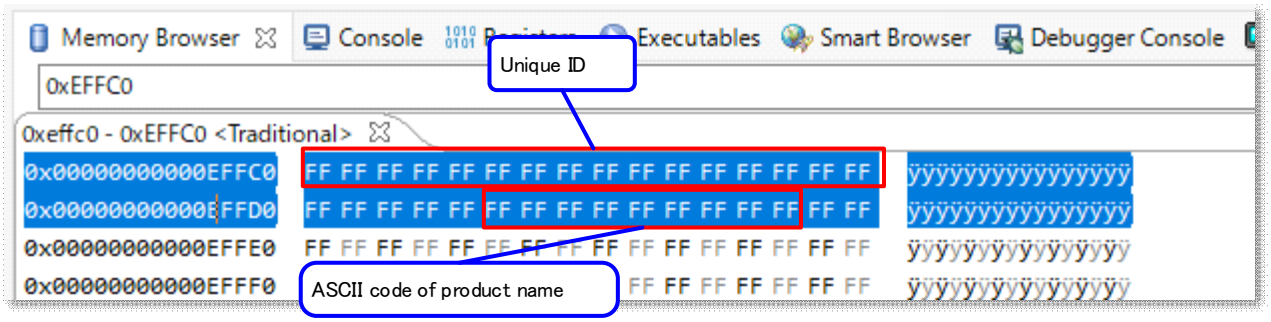
7.2 Settings and Execution

1. Connect the USB port of the PC to the micro USB port of the RL78/G23 Fast Prototyping Board as shown in Figure 7.1, RL78/G23 Fast Prototyping Board Device Connection Diagram.
2. Launch the terminal emulation program (terminal software) on the PC. Then select the serial COM port assigned to the USB serial converter board.
3. Make serial communication settings in the terminal software to match those of the sample application: 115,200 bps, 8 data bits, no parity, 1 stop bit, no flow control.
4. Build the sample application, download it to the RL78/G23 Fast Prototyping Board, and use the debugger to run the application.
5. When the software runs, the unique ID and product name are output to the terminal, after which the program terminates normally.

```
unique ID[HEX]: 2e 18 17 30 33 30 38 31 30 33 fc b7 71 29 57 4b
product name  : R7F100GLG
```

7.3 Note on Debugging

The flash memory area where the unique ID and product name ASCII code are stored cannot be read using the debugger's memory browser; FFH is displayed instead.



8. Reference Documents

RL78/G23 Group User's Manual: Hardware (R01UH0896E)

RL78 Family User's Manual: Software (R01US0015E)

Technical Update/Technical News

(The latest information can be downloaded from the Renesas Electronics website.)

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Apr. 13, 2021	—	First edition issued

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit 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. Precaution against Electrostatic Discharge (ESD)

   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on

   The state of the product is undefined at the time 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 time 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 time 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 time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state

   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
4. Handling of unused pins

   Handle unused pins in accordance 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 the 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.
5. Clock signals

   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is 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. Additionally, 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.
6. Voltage application waveform at input pin

   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
7. Prohibition of access to reserved addresses

   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.
8. Differences between products

   Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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