Application Report

C2000™ Unique Device Number

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ABSTRACT

This document discusses the 32-bit value which is stored in each device during manufacturing. It describes how this value can be used as a unique device identifier, as well as the limitations associated with using this value to generate an encryption key.

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Trademarks

C2000™ is a trademark of Texas Instruments.
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1 Introduction

Many C2000™ devices contain a unique device number which can be used by an application for enhancing a security solution. This unique device number may be used in a variety of ways. The following are some examples in which the unique device number may be used.

- Protection against code cloning using periodic read back and compares
- Initialization vector (IV) for encryption or decryption of a program or data
- IV for authentication
- Device identification in communications (broadcasting)
- Seed for data integrity algorithms, for example, cyclic redundancy check (CRC)

The implementation of the unique device number has evolved as the C2000 technology and devices have advanced. There are two classes of devices which are distinguished as Class-A and Class-B for the following discussion.

Class-A devices:

- F280x
- F2802x
- F2803x
- F2805x
- F2806x
- F2823x and F2833x

Class-B devices:

- F2807x
- F2837x
- F28004x
- F2838x
- F28002x

2 Class-A Devices

For Class-A devices, the device number is pseudo-unique. The term pseudo is meant to clearly communicate that TI does not guarantee the value will be unique for every device, but rather that it should generally be unique.

The 32-bit value provided can be considered as two, 16-bit words. For optimum uniqueness over time, all 32 bits should be used. If only 16 bits are required, TI recommends that the least significant word (LSW) and most significant word (MSW) be XOR'd together. If this cannot be done, then the LSW should be used because the MSW alone may not contain enough variability across material to meet the desired requirements. For more information, see Section 2.1 and Section 2.1.1.

2.1 Limitations

There are a few limitations and restrictions which must be communicated for a proper evaluation concerning whether this value will work for the intended purpose in the customer application.

2.1.1 Variability

The 32-bit value is not a pseudo randomly generated number, but is instead based on simple serialization algorithms. Devices manufactured near the same time may have the same or similar MSWs, but should typically have unique LSWs. Under typical situations, LSWs may repeat within a few hundred devices or a few thousand. By using the MSW and LSW together the probability that a device number is repeated is greatly reduced.

2.1.2 Static Bits

Some of the bits within the 32-bit value will generally have a fixed value of zero. Static bits reduce the possible values for the 32-bit number. There is one static bit in the MSW and four static bits in the LSW.

2.1.3 Long-Term Reliability

The 32-bit value is not guaranteed to remain consistent across all operating conditions for the full life of the device. If the value is used, it should be copied into an on-chip, nonvolatile location, such as the user one-time programmable (OTP) memory or flash.

2.1.4 Not Tested

Devices are not rejected during factory test based on the 32-bit value. The consequence is that multiple devices may be programmed with a common value, particularly all bits being zero or one, or some other nonstandard value.

3 Class-B Devices

Class-B devices have a different offering than Class-A devices. Class-B devices offer UID_REGS registers in the OTP for device identification. The UID_REGS registers consists of a 256-bit value that is made up of both pseudo-random and sequential parts. This value can be used as a seed for code encryption. The first 192 bits are pseudo-random, the next 32 bits are sequential, and the last 32 bits are a fletcher checksum value of the previous 224 bits.

The 32-bit sequential value is the UID_UNIQUE device identification register and is unique for all devices of a particular device family (for example, F2807x, F2837x, and so on). Due to this, the 256-bit value is also unique.

3.1 Limitations and Variability

There are a few limitations and restrictions which must be communicated for a proper evaluation concerning whether this value will work for the intended purpose in the customer application.

The 192-bit, pseudo-random value is not guaranteed to have a particular degree of entropy. Therefore, use of the pseudo-random value as a cryptographic key should be carefully considered against the threat level the application must protect against. Use in cryptography as an IV is acceptable, provided there is no requirement of entropy for the IV.

The 32-bit UID_UNIQUE value is not a randomly generated pseudo-number, but is instead based on simple serialization algorithms. Although the UID_UNIQUE value is unique to a unit within a particular series of devices, there will be instances where across device series two units will carry the same UID_UNIQUE number. If uniqueness across device series is required, the UID_UNIQUE value should be cross referenced with the PARTIDH value listed in the device data sheet.

4 Device Table

Table 4-1 lists the memory mapped address from where the MSW and LSW can be read for several device families.

Table 4-1. Unique ID Locations on C2000 Devices

Device Family	MSW Location	LSW Location
F24x and F240x	N/A	N/A
F280x	0x000809	0x000808
F2802x	0x000901	0x000900
F2803x	0x000901	0x000900
F2805x	0x3D7FDB	0x3D7FDA
F2806x	0x000901	0x000900
F2823x and F2833x	0x000901	0x000900
F2807x(1)	0x0703CD	0x0703CC
F2837x(1)	0x0703CD	0x0703CC
F28004x(1)	0x0703CD	0x0703CC
F2838x(1)	0x07020D	0x07020C
F28002x(1)	0x0701F5	0x0701F4

(1) See the device data sheet and technical reference manual for more information regarding this UID_UNIQUE register.

5 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision A (June 2019) to Revision B (September 2020)	Page
• Updated the numbering format for tables, figures and cross-references throughout the document	2
• Update was made in Section 1	2
• Update was made in Section 4	4