**Firmware - Internal Flash Memory Structure**

In this section the reader will be able to understand the internal flash memory structure the microcontrollers. To ensure the consistency, each microcontroller should respect the following flash memory structure if and only if the board supports firmware upgrade and versioning. The Flash memory should be compliant with the following schema/table:

0x0802001F

0x08020000

0x0801FFFF

0x0801FF00

0x0801FEFF

0x08000440

0x080XXXXX

0x08020460

0x08020420

0x08020020

0x08000400

0x08000000

Internal Flash Memory

**IFMAPPL**

**IFMBOOT**

**IFMAPPINFO**

**IFMDEVINFO**

**\_SOFTINFO**

**\_SOFTINFO**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sector/Area name** | **Memory Address** | **Size** | **Description** |
| **IFMBOOT** | 0x08000000 - 0x0801FEFF | 130815 bytes | In this sector, we place the Bootloader firmware |
| IFMBOOT\_SOFTINFO | 0x08000400 - 0x08000440 | 64 bytes | Software Information (Bootloader) |
| **IFMDEVINFO** | 0x0801FF00 - 0x0801FFFF | 256 bytes | Contains the Serial Number of the Board, the Manufacturing/Production Date as well as any other information related to the board manufacturing procedure and identification. Please ref to the Table: [IFMDEVINFO and IFMDEVINFO\_EX] |
| **IFMAPPINFO** | 0x08020000 - 0x0802001F | 32 bytes | Contain information regarding the Application Firmware Installation: Operator Code, Date, Size, CRC etc |
| **IFMAPPL** | 0x08020020 - 0x080XXXXX | ~Max bytes | In this sector, we place the Application firmware |
| IFMAPP\_SOFTINFO | 0x8020420 - 0x08020460 | 64 bytes | Software Information (Application) |

Table : Firmware Flash Memory Sectors

A generic data structure template of the IFMDEVINFO, IFMAPPINFO, \*\_SOFTINFO sectors is presented below:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Byte #** | **Field Name** | **Size** | **Order** | **Description** |
| 0 | AVC | 2 bytes | MSB | CRC16\_CCIT value calculation of the sector |
| 1 | LSB |
| 2 | FN | 1 byte | - | Field Name/Type |
| 3 | FS | 1 byte |  | Field Size |
| 4 – 4+FS | FD[x] | FS bytes | Depends | Field Data |
| n+1 | FN | 1 byte | - | Field Name/Type |
| n+2 | FS | 1 byte |  | Field Size |
| n+3 – n+3+FS | FD[x] | FS bytes | Depends | Field Data |

Table : IFMDEVINFO and IFMAPPINFO Sector Structure

**Sector Details: IFMBOOT**

This sector contains bootloader firmware details. To expose some software related information, the bootloader firmware contains a fixed allocated area starting at 0x8000400 address.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Field Name** | | **Size** | | **Value** | **Description** | | |
| IFMBOOT\_SOFTINFO\_CRC | | 2 bytes | | - | CRC16\_CCIT value calculation of the 64(-2) bytes area | | |
| IFMBOOT\_SOFTINFO\_SI | | 1 byte | | 0xF1 | Indicate the Boot Software Identification (Code.Version) [UDS:BSIDID] | | |
| IFMBOOT\_SOFTINFO\_SISZ | | 1 byte | | - | Indicate the Boot Software Identification (Code.Version) Data Size | | |
| IFMBOOT\_SOFTINFO\_SIDT[x] | | X bytes [d:14] | | - |  | | |
| IFMBOOT\_SOFTINFO\_UV | | 1 byte | | 0xF3 | Indicate the UDS Version [UDS:ECUMDDID] | | |
| IFMBOOT\_SOFTINFO\_UVSZ | | 1 byte | | - | Indicate the UDS Version Data Size | | |
| IFMBOOT\_SOFTINFO\_UVDT[x] | | X bytes [d:4] | | - |  | | |
| IFMBOOT\_SOFTINFO\_CB | | 1 byte | | 0xF4 | Indicate the CANBus support [UDS:VMECUHNDID] | | |
| IFMBOOT\_SOFTINFO\_CBSZ | | 1 byte | | - | Indicate the CANBus support Data Size | | |
| IFMBOOT\_SOFTINFO\_CBDT[x] | | 1 bytes [d:1] | | - |  | | |
| IFMBOOT\_SOFTINFO\_CA | | 1 | | 0xF2 | Indicate the compatible Application Software Identification | | |
| IFMBOOT\_SOFTINFO\_CASZ | | 1 | | - | Indicate the Application Software Identification Data Size | | |
| IFMBOOT\_SOFTINFO\_CADT[x] | | X bytes [d:10] | |  |  | | |
| **Byte #** | **Generic Field Name** | | **Size** | **Order** | | **Value** | **Details** |
| 0 | IFMBOOT\_SOFTINFO\_CRC | | 2 bytes | MSB | | ? | IFMBOOT\_SOFTINFO area CRC16\_CCIT value |
| 1 | LSB | | ? |
| 2 | IFMBOOT\_SOFTINFO\_SI | | 1 byte |  | | 0xF1 | Boot Software Identification |
| 3 | IFMBOOT\_SOFTINFO\_SISZ | | 1 byte |  | | 0x0E | 14 bytes |
| 4 | IFMBOOT\_SOFTINFO\_SIDT [0] | | 1/14 bytes |  | | … | Ex: EN.F000000.000 |
| … | IFMBOOT\_SOFTINFO\_SIDT […] | | … |  | | … |
| 11 | IFMBOOT\_SOFTINFO\_SIDT [13] | | 14/14 bytes |  | | … |
| 12 | IFMBOOT\_SOFTINFO\_CA | | 1 byte |  | | 0xF2 | Compatible Application Software Identification |
| 13 | IFMBOOT\_SOFTINFO\_CASZ | | 1 byte |  | | 0x0E | 14 bytes |
| 14 | IFMBOOT\_SOFTINFO\_CADT [0] | | 1/10 bytes |  | |  | Ex: EN.F000006 |
| … | IFMBOOT\_SOFTINFO\_CADT […] | | … |  | |  |
| 24 | IFMBOOT\_SOFTINFO\_CADT [9] | | 10/10 bytes |  | |  |
| 25 | IFMBOOT\_SOFTINFO\_UV | | 1 byte |  | | 0xF3 | UDS Version |
| 26 | IFMBOOT\_SOFTINFO\_UVSZ | | 1 byte |  | | 0x04 | 4 bytes |
| 27 | IFMBOOT\_SOFTINFO\_UVDT [0] | | 1/4 bytes |  | | … | Ex: 1000 (1.0.0.0) |
| … | IFMBOOT\_SOFTINFO\_UVDT […] | | … |  | | … |
| 31 | IFMBOOT\_SOFTINFO\_UVDT [3] | | 4/4 bytes |  | | … |
| 32 | IFMBOOT\_SOFTINFO\_CB | | 1 byte |  | | 0xF4 | CANBus support (Code.Version) |
| 33 | IFMBOOT\_SOFTINFO\_CBSZ | | 1 byte |  | | 0x01 | 1 byte |
| 34 | IFMBOOT\_SOFTINFO\_CBDT [0] | | 1 bytes | - | | … | Ex: 1 (CANBus Classic) |
| … | Invalidated byte | |  |  | | 0x00 |  |
| 64 | Invalidated byte | |  |  | | 0x00 |  |

**Sector Details: IFMAPP**

This sector contains application firmware details. To expose some software related information, the application firmware contains a fixed allocated area starting at 0x8020420 address.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Field Name** | | **Size** | | **Value** | **Description** | | |
| IFMAPP\_SOFTINFO\_CRC | | 2 bytes | | - | CRC16\_CCIT value calculation of the 64(-2) bytes area | | |
| IFMAPP\_SOFTINFO\_SI | | 1 byte | | 0XE1 | Indicate the Application Software Identification (Code.Version) [UDS:ASIDID] | | |
| IFMAPP\_SOFTINFO\_SISZ | | 1 byte | | - | Indicate the Application Software Identification (Code.Version) Data Size | | |
| IFMAPP\_SOFTINFO\_SIDT[x] | | X bytes [d:10] | | - |  | | |
| IFMAPP\_SOFTINFO\_UV | | 1 byte | | 0xE2 | Indicate the UDS Version [UDS:ECUMDDID] | | |
| IFMAPP\_SOFTINFO\_UVSZ | | 1 byte | | - | Indicate the UDS Version Data Size | | |
| IFMAPP\_SOFTINFO\_UVDT[x] | | X bytes [d:4] | | - |  | | |
| IFMAPP\_SOFTINFO\_CB | | 1 byte | | 0xE3 | Indicate the CANBus support [UDS:VMECUHNDID] | | |
| IFMAPP\_SOFTINFO\_CBSZ | | 1 byte | | - | Indicate the CANBus support Data Size | | |
| IFMAPP\_SOFTINFO\_CBDT[x] | | X bytes [d:1] | | - |  | | |
| **Byte #** | **Generic Field Name** | | **Size** | **Order** | | **Value** | **Details** |
| 0 | IFMAPP\_SOFTINFO\_CRC | | 2 bytes | MSB | | ? | IFMAPP\_SOFTINFO area CRC16\_CCIT value |
| 1 | LSB | | ? |
| 2 | IFMAPP\_SOFTINFO\_SI | | 1 byte |  | | 0xE1 | Application Software Identification |
| 3 | IFMAPP\_SOFTINFO\_SISZ | | 1 byte |  | | 0x0E | 14 bytes |
| 4 | IFMAPP\_SOFTINFO\_SIDT [0] | | 1/8 bytes |  | | … | Ex: EN.F000000.000 |
| … | IFMAPP\_SOFTINFO\_SIDT […] | | … |  | | … |
| 11 | IFMAPP\_SOFTINFO\_SIDT [7] | | 14/14 bytes |  | | … |
| 12 | IFMAPP\_SOFTINFO\_UV | | 1 byte |  | | 0xE2 | UDS Version |
| 13 | IFMAPP\_SOFTINFO\_UVSZ | | 1 byte |  | | 0x0A | 10 bytes |
| 14 | IFMAPP\_SOFTINFO\_UVDT [0] | | 1/4 bytes |  | | … | Ex: 1000 (1.0.0.0) |
| … | IFMAPP\_SOFTINFO\_UVDT […] | | … |  | | … |
| 24 | IFMAPP\_SOFTINFO\_UVDT [3] | | 4/4 bytes |  | | … |
| 25 | IFMAPP\_SOFTINFO\_CB | | 1 byte |  | | 0xE3 | CANBus support (Code.Version) |
| 26 | IFMAPP\_SOFTINFO\_CBSZ | | 1 byte |  | | 0x01 | 1 byte |
| 27 | IFMAPP\_SOFTINFO\_CBDT [0] | | 1 bytes | - | | … | Ex: 1 (CANBus Classic) |
| … | Invalidated byte | |  |  | | 0x00 |  |
| 64 | Invalidated byte | |  |  | | 0x00 |  |

**Sector Details: IFMDEVINFO**

This sector contains the constant device information. During the manufacturing, this sector must be erased and written by the EOL (programmer) tool according to the specifications below.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Field Name** | | **Size** | | **Value** | **Description** | | |
| IFMDEVINFOCRC | | 2 bytes | | - | CRC16\_CCIT value calculation of the 256(-2) bytes area | | |
| IFMDEVINFOSN | | 1 byte | | 0x11 | Indicate the ECU Serial Number [UDS:ECUSNDID] | | |
| IFMDEVINFOSNSZ | | 1 byte | | - | Indicate the ECU Serial Number Data Size | | |
| IFMDEVINFOSNDT[x] | | X bytes [d:10] | | - |  | | |
| IFMDEVINFOMD | | 1 byte | | 0x12 | Indicate the Manufacturing Date [UDS:ECUMDDID] | | |
| IFMDEVINFOMDSZ | | 1 byte | | - | Indicate the Manufacturing Date Data Size | | |
| IFMDEVINFOMDDT[x] | | X bytes [d:8] | | - |  | | |
| IFMDEVINFOHC | | 1 byte | | 0x13 | Indicate the Hardware Number (Code.Version) [UDS:VMECUHNDID] | | |
| IFMDEVINFOHCSZ | | 1 byte | | - | Indicate the Hardware Number (Code.Version) Data Size | | |
| IFMDEVINFOHCDT[x] | | X bytes [d:14] | | - |  | | |
| IFMDEVINFOOP | | 1 byte | | 0x14 | (optional) Indicate any device static parameters | | |
| IFMDEVINFOOPSZ | | 1 byte | | - | Indicate any device static parameters Data Size | | |
| IFMDEVINFOOPDT[x] | | X bytes | | - |  | | |
| **Byte #** | **Generic Field Name** | | **Size** | **Order** | | **Value** | **Details** |
| 0 | IFMDEVINFOCRC | | 2 bytes | MSB | | ? | IFMDEVINFO sector CRC16\_CCIT value |
| 1 | LSB | | ? |
| 2 | IFMDEVINFOMD | | 1 byte |  | | 0x12 | Indicate the Manufacturing Date [UDS: ECUMDDID] |
| 3 | IFMDEVINFOMDSZ | | 1 byte |  | | 0x08 | 8 bytes |
| 4 | IFMDEVINFOMDDT [0] | | 1/8 bytes |  | | … | Ex: 20210823 (YYYYMMDD) |
| … | IFMDEVINFOMDDT […] | | … |  | | … |
| 11 | IFMDEVINFOMDDT [7] | | 8/8 bytes |  | | … |
| 12 | IFMDEVINFOSN | | 1 byte |  | | 0x11 | ECU Serial Number |
| 13 | IFMDEVINFOSNSZ | | 1 byte |  | | 0x0A | 10 bytes |
| 14 | IFMDEVINFOSNDT [0] | | 1/10 bytes |  | | … | Ex: S23PQ678RT |
| … | IFMDEVINFOSNDT […] | | … |  | | … |
| 24 | IFMDEVINFOSNDT [9] | | 10/10 bytes |  | | … |
| 25 | IFMDEVINFOHC | | 1 byte |  | | 0x13 | Hardware Number (Code.Version) |
| 26 | IFMDEVINFOHCSZ | | 1 byte |  | | 0x04 | 14 bytes |
| 27 | IFMDEVINFOHCDT [0] | | 1/14 bytes | - | | … | Ex: EN.W000000.000 |
| … | IFMDEVINFOHCDT […] | | … | - | | … |
| 41 | IFMDEVINFOHCDT [13] | | 14/14 bytes | - | | … |
| 42 | IFMDEVINFOOP | | 1 byte |  | | 0x14 | Device static parameters |
| 43 | IFMDEVINFOOPSZ | | 1 byte |  | | 0x04 | X bytes |
| 44 | IFMDEVINFOOPDT [0] | | 1/X bytes | - | | … | Optional data field. Can be also removed |
| … | IFMDEVINFOOPDT […] | | … | - | | … |
| X | IFMDEVINFOOPDT [X] | | X/X bytes | - | | … |
| … | Invalidated byte | |  |  | | 0x00 |  |
| 256 | Invalidated byte | |  |  | | 0x00 |  |

**Sector Details: IFMAPPINFO**

This sector contains information about the application firmware upgrade operation. During the application firmware upgrade procedure (performed by the bootloader firmware), this sector must be erased when the erase memory request is received and written with the updated values when the VAFAFUP (Validate and Finalize Application Firmware Upgrade procedure) request is asserted.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Field Name** | | **Size** | | **Value** | **Description** | | |
| IFMAPPINFOCRC | | 2 bytes | | - | CRC16\_CCIT value calculation of the 32(-2) bytes area | | |
| IFMAPPINFOPD | | 1 byte | | 0x21 | Indicate the Programming Date [UDS:PDDID] | | |
| IFMAPPINFOPDSZ | | 1 byte | | - | Indicate the Programming Date Data Size | | |
| IFMAPPINFOPDDT[x] | | X bytes [d:8] | | - |  | | |
| IFMAPPINFOOC | | 1 byte | | 0x22 | Indicate the Operator Code | | |
| IFMAPPINFOOCSZ | | 1 byte | | - | Indicate the Operator Code Data Size | | |
| IFMAPPINFOOCDT[x] | | X bytes [d:2] | | - |  | | |
| IFMAPPINFOFS | | 1 byte | | 0x23 | Indicate the Firmware Size | | |
| IFMAPPINFOFSSZ | | 1 byte | | - | Indicate the Firmware Size Data Size | | |
| IFMAPPINFOFSDT[x] | | X bytes [d:4] | | - |  | | |
| IFMAPPINFOFV | | 1 byte | | 0x24 | Indicate the Firmware CRC | | |
| IFMAPPINFOFVSZ | | 1 byte | | - | Indicate the Firmware CRC Data Size | | |
| IFMAPPINFOFVDT[x] | | X bytes [d:2] | | - |  | | |
| **Byte #** | **Generic Field Name** | | **Size** | **Order** | | **Value** | **Description** |
| 0 | IFMAPPINFOCRC | | 2 bytes | MSB | | ? | IFMAPPINFO sector CRC16\_CCIT value |
| 1 | LSB | | ? |
| 2 | IFMAPPINFOPD | | 1 byte |  | | 0x21 | Programming Date |
| 3 | IFMAPPINFOPDSZ | | 1 byte |  | | 0x08 | Field Size of 8 bytes |
| 4 | IFMAPPINFOPDDT [0] | | 1/8 bytes | - | |  | Ex: 20210823 (YYYYMMDD) |
| … | IFMAPPINFOPDDT […] | | … | - | |  |
| 11 | IFMAPPINFOPDDT [7] | | 8/8 bytes | - | |  |
| 12 | IFMAPPINFOOC | | 1 byte |  | | 0x22 | Operator Code |
| 13 | IFMAPPINFOOCSZ | | 1 byte |  | | 0x02 | 2 bytes |
| 14 | IFMAPPINFOOCDT [0] | | 1/2 bytes | MSB | | 0X1F | Ex: Nick has the OpCode 0x1F28 |
| 15 | IFMAPPINFOOCDT [1] | | 2/2 bytes | LSB | | 0x28 |
| 16 | IFMAPPINFOFS | | 1 byte |  | | 0x23 | Firmware Size |
| 17 | IFMAPPINFOFSSZ | | 1 byte |  | | 0x04 | 4 bytes |
| 18 | IFMAPPINFOFSDT [0] | | 1/4 bytes | MSB | | 0X00 | 132018 bytes  (0x000203B2) |
| 19 | IFMAPPINFOFSDT [1] | | 2/4 bytes | - | | 0x02 |
| 20 | IFMAPPINFOFSDT [2] | | 3/4 bytes | - | | 0x03 |
| 21 | IFMAPPINFOFSDT [3] | | 4/4 bytes | LSB | | 0xB2 |
| 22 | IFMAPPINFOFV | | 1 byte |  | | 0x24 | Firmware CRC |
| 23 | IFMAPPINFOFVSZ | | 1 byte |  | | 0x04 | 2 bytes |
| 24 | IFMAPPINFOFVDT [0] | | 1/2 bytes | MSB | | 0X32 | Ex: 0x3230 |
| 25 | IFMAPPINFOFVDT [1] | | 2/2 bytes | LSB | | 0x30 |
| … | Invalidated byte | |  |  | | 0x00 |  |
| 31 | Invalidated byte | |  |  | | 0x00 |  |