Secure Bootloader with Rollback Feature

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Generated by Doxygen 1.9.1

Chapter 1

Class Index

1.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 2

File Index

2.1 File List

Here is a list of all files with brief descriptions:

Chapter 3

Class Documentation

3.1 App_INFO_t Struct Reference

```
#include <bl_typedef.h>
```

Public Attributes

- uint8_t hash [32]
- uint32_t app_size
- uint8_t app_validity

3.1.1 Member Data Documentation

3.1.1.1 app_size

```
uint32_t App_INFO_t::app_size
```

3.1.1.2 app_validity

```
uint8_t App_INFO_t::app_validity
```

3.1.1.3 hash

```
uint8_t App_INFO_t::hash[32]
```

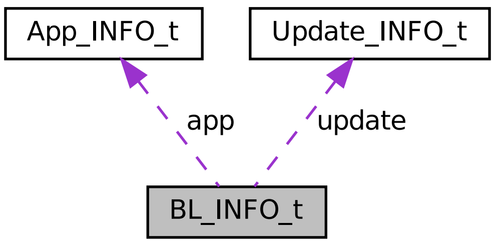
The documentation for this struct was generated from the following file:

- bootloader/bl_typedef.h

3.2 BL_INFO_t Struct Reference

```
#include <bl_typedef.h>
```

Collaboration diagram for BL_INFO_t:



Public Attributes

- App_INFO_t app
- Update_INFO_t update

3.2.1 Member Data Documentation

3.2.1.1 app

```
App_INFO_t BL_INFO_t::app
```

3.2.1.2 update

```
Update_INFO_t BL_INFO_t::update
```

The documentation for this struct was generated from the following file:

- bootloader/bl_typedef.h

3.3 CRC_Handle_t Struct Reference

```
#include <crc_typedefs.h>
```

Public Attributes

- uint32_t crc_poly
- uint32_t crc_initval
- uint32_t crc_reg

3.3.1 Member Data Documentation

3.3.1.1 crc_initval

```
uint32_t CRC_Handle_t::crc_initval
```

3.3.1.2 crc_poly

```
uint32_t CRC_Handle_t::crc_poly
```

3.3.1.3 crc_reg

```
uint32_t CRC_Handle_t::crc_reg
```

The documentation for this struct was generated from the following file:

- crc/crc_typedefs.h

3.4 Update_INFO_t Struct Reference

```
#include <bl_typedef.h>
```

Public Attributes

- uint8_t hash [32]
- uint32_t update_size
- uint8_t updated

3.4.1 Member Data Documentation

3.4.1.1 hash

```
uint8_t Update_INFO_t::hash[32]
```

3.4.1.2 update_size

```
uint32_t Update_INFO_t::update_size
```

3.4.1.3 updated

```
uint8_t Update_INFO_t::updated
```

The documentation for this struct was generated from the following file:

- bootloader/bl_typedef.h

3.5 Version_ID_t Struct Reference

```
#include <bl_typedef.h>
```

Public Attributes

- uint8_t vendor_id
- uint8_t major_version
- uint8_t minor_version
- uint8_t patch_version

3.5.1 Member Data Documentation

3.5.1.1 major_version

```
uint8_t Version_ID_t::major_version
```

3.5.1.2 minor_version

```
uint8_t Version_ID_t::minor_version
```

3.5.1.3 patch_version

```
uint8_t Version_ID_t::patch_version
```

3.5.1.4 vendor_id

```
uint8_t Version_ID_t::vendor_id
```

The documentation for this struct was generated from the following file:

- bootloader/bl_typedef.h

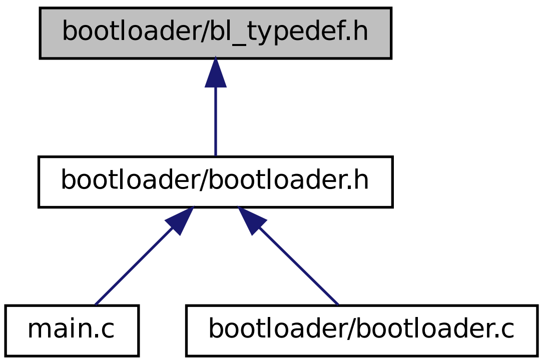
Chapter 4

File Documentation

4.1 bootloader/bl_typedef.h File Reference

: Header file for typedefs for the STM32F103C8T6 Bootloader.

This graph shows which files directly or indirectly include this file:



Classes

- struct App_INFO_t
- struct Update_INFO_t
- struct BL_INFO_t
- struct Version_ID_t

Macros

- #define CRC_VERIFY_PASS 0x01
- #define CRC_VERIFY_FAIL 0x00
- #define APP_VERIFIED 0x00
- #define APP_NOT_VERIFIED 0x01
- #define APP_NOT_FOUND 0x02
- #define UPDATE_FOUND 0x03
- #define NOR_APP_NOT_UPDATE_FOUND 0x04
- #define VERIFICATION_ERROR 0x05
- #define STM32F103C8T6_PAGES_NUM 64
- #define PAGE0_ADDRESS 0x08000000
- #define PAGE_SIZE (1024u)
- #define BL_CRC_SIZE 0x04u

Typedefs

- typedef enum BL_CMD BL_CMD
- typedef enum BL_STATUS BL_STATUS

Enumerations

- enum BL_CMD {
  CBL_GET_VER_CMD = 1 , CBL_GET_CID_CMD , CBL_MEM_READ_CMD , CBL_FLASH_ERASE_CMD ,
  CBL_GET_RDP_STATUS_CMD , CBL_GET_APP_UPDATE , CBL_JUMPTOAPP , CBL_GET_HELP_CMD
  }
- enum BL_STATUS { BL_ACK = 0xA5 , BL_NACK = 0x5A }

4.1.1 Detailed Description

: Header file for typedefs for the STM32F103C8T6 Bootloader.

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4.1.2 Macro Definition Documentation

4.1.2.1 APP_NOT_FOUND

```
#define APP_NOT_FOUND 0x02
```

4.1.2.2 APP_NOT_VERIFIED

```
#define APP_NOT_VERIFIED 0x01
```

4.1.2.3 APP_VERIFIED

```
#define APP_VERIFIED 0x00
```

4.1.2.4 BL_CRC_SIZE

```
#define BL_CRC_SIZE 0x04u
```

4.1.2.5 CRC_VERIFY_FAIL

```
#define CRC_VERIFY_FAIL 0x00
```

4.1.2.6 CRC_VERIFY_PASS

```
#define CRC_VERIFY_PASS 0x01
```

4.1.2.7 NOR_APP_NOT_UPDATE_FOUND

```
#define NOR_APP_NOT_UPDATE_FOUND 0x04
```

4.1.2.8 PAGE0_ADDRESS

```
#define PAGE0_ADDRESS 0x08000000
```

4.1.2.9 PAGE_SIZE

```
#define PAGE_SIZE (1024u)
```

4.1.2.10 STM32F103C8T6_PAGES_NUM

```
#define STM32F103C8T6_PAGES_NUM 64
```

4.1.2.11 UPDATE_FOUND

```
#define UPDATE_FOUND 0x03
```

4.1.2.12 VERIFICATION_ERROR

```
#define VERIFICATION_ERROR 0x05
```

4.1.3 Typedef Documentation

4.1.3.1 BL_CMD

```
typedef enum BL_CMD BL_CMD
```

4.1.3.2 BL_STATUS

```
typedef enum BL_STATUS BL_STATUS
```

4.1.4 Enumeration Type Documentation

4.1.4.1 BL_CMD

```
enum BL_CMD
```

Enumerator

CBL_GET_VER_CMD	
CBL_GET_CID_CMD	
CBL_MEM_READ_CMD	
CBL_FLASH_ERASE_CMD	
CBL_GET_RDP_STATUS_CMD	
CBL_GET_APP_UPDATE	
CBL_JUMPTOAPP	
CBL_GET_HELP_CMD	

4.1.4.2 BL_STATUS

```
enum BL_STATUS
```

Enumerator

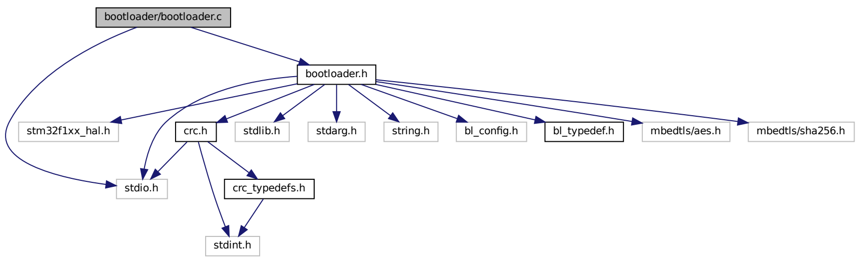
BL_ACK	
BL_NACK	

4.2 bootloader/bootloader.c File Reference

: Source file for the STM32F103C8T6 Bootloader.

```
#include "bootloader.h"
#include <stdio.h>
```

Include dependency graph for bootloader.c:



Functions

- void BL_JumpToApplication (uint8_t app_starting_page)
- void BL_JumpToApplication_Wrapper (uint8_t ∗hostbuffer)
- void Bootloader_MemRead (uint32_t address, size_t len)

  Reads data from the specified memory address after authorization.
- uint8_t Set_ValidUpdate (Update_INFO_t ∗update)
- BL_STATUS BL_WriteToFlash (uint8_t page, uint8_t ∗data, uint32_t size)
- BL_STATUS BL_WriteAppsInfoToFlash (BL_INFO_t ∗info)

  Writes application info structure to flash memory.
- BL_STATUS BL_FetchUARTCommand (void)

  Fetches the UART command sent to the bootloader.
- uint8_t BL_VerifyApplication (void)

  Verifies if an application is present and valid in memory.
- void Get_CurrentBL_Info (BL_INFO_t ∗dest)

  Retrieves the current bootloader information.
- void BL_DeInit ()

Deinitializes all peripherals used by the bootloader.
- void BL_SendAck (uint8_t ack)

  Sends an acknowledgment byte via UART.
- uint8_t BL_InstallApplication (void)

  Installs the new application from the update location in Flash memory to the application location.
- void BL_Init ()
- void BL_SendMSG (UART_HandleTypeDef ∗huart, char ∗format,...)
- void generate_random_number (uint8_t ∗output)

  Generates a random number using the system tick and stores it in the output.

Variables

- BL_INFO_t ∗ bl_info_ptr = (BL_INFO_t∗) (BL_INFO_PAGE ∗ PAGE_SIZE + PAGE0_ADDRESS)

4.2.1 Detailed Description

: Source file for the STM32F103C8T6 Bootloader.

Attention

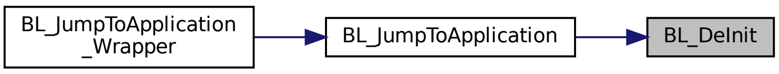
4.2.2 Function Documentation

4.2.2.1 BL_DeInit()

```
void BL_DeInit ( )
```

Deinitializes all peripherals used by the bootloader.

Here is the caller graph for this function:



4.2.2.2 BL_FetchUARTCommand()

```
BL_STATUS BL_FetchUARTCommand (
            void  )
```

Fetches the UART command sent to the bootloader.

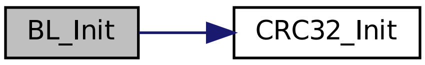
Return values

BL_STATUS	Status of the bootloader command (ACK/NACK).

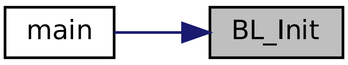
4.2.2.3 BL_Init()

```
void BL_Init ( )
```

Here is the call graph for this function:



Here is the caller graph for this function:



4.2.2.4 BL_InstallApplication()

```
uint8_t BL_InstallApplication (
            void )
```

Installs the new application from the update location in Flash memory to the application location.

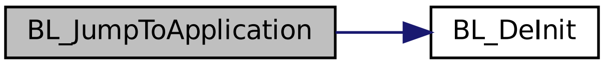
Return values

uint8↩ _t	Returns 0 if installation is successful, or 1 if there is an error.

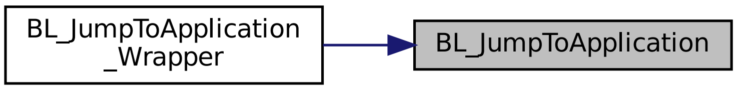
4.2.2.5 BL_JumpToApplication()

```
void BL_JumpToApplication (
            uint8_t app_starting_page )
```

Here is the call graph for this function:



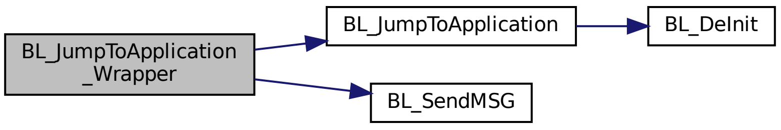
Here is the caller graph for this function:



4.2.2.6 BL_JumpToApplication_Wrapper()

```
void BL_JumpToApplication_Wrapper (
            uint8_t * hostbuffer )
```

Here is the call graph for this function:



4.2.2.7 BL_SendAck()

```
void BL_SendAck (
            uint8_t ack )
```

Sends an acknowledgment byte via UART.

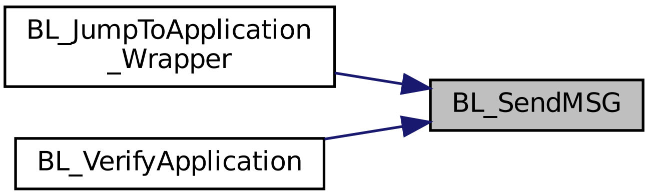
Parameters

ack	The acknowledgment byte to be sent.

4.2.2.8 BL_SendMSG()

```
void BL_SendMSG (
            UART_HandleTypeDef * huart,
            char * format,
             ... )
```

Here is the caller graph for this function:



4.2.2.9 BL_VerifyApplication()

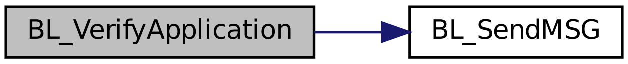
```
uint8_t BL_VerifyApplication (
            void )
```

Verifies if an application is present and valid in memory.

Return values

uint8←↩ _t	Status of the verification.

Here is the call graph for this function:



4.2.2.10 BL_WriteAppsInfoToFlash()

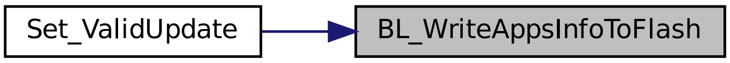
```
BL_STATUS BL_WriteAppsInfoToFlash (
            BL_INFO_t * info )
```

Writes application info structure to flash memory.

Parameters

info	Pointer to BL_INFO_t structure containing app info to write.

Here is the caller graph for this function:



4.2.2.11 BL_WriteToFlash()

```
BL_STATUS BL_WriteToFlash (
            uint8_t page,
            uint8_t * data,
            uint32_t size )
```

4.2.2.12 Bootloader_MemRead()

```
void Bootloader_MemRead (
             uint32_t address,
             size_t len )
```

Reads data from the specified memory address after authorization.

Parameters

address	Starting address to read from.
len	Number of bytes to read.

4.2.2.13 generate_random_number()

```
void generate_random_number (
             uint8_t * output )
```

Generates a random number using the system tick and stores it in the output.

Parameters

output	Pointer to store the generated random number (16 bytes).

4.2.2.14 Get_CurrentBL_Info()

```
void Get_CurrentBL_Info (
             BL_INFO_t * dest )
```

Retrieves the current bootloader information.

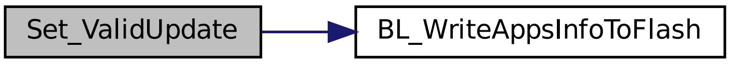
Parameters

dest	Pointer to the destination structure to store bootloader info.

4.2.2.15 Set_ValidUpdate()

```
uint8_t Set_ValidUpdate (
             Update_INFO_t * update )
```

Here is the call graph for this function:



4.2.3 Variable Documentation

4.2.3.1 bl_info_ptr

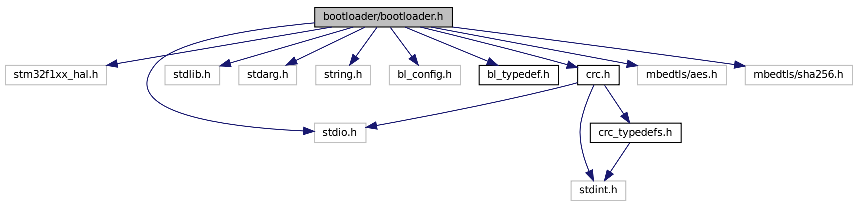
```
BL_INFO_t* bl_info_ptr = (BL_INFO_t*) (BL_INFO_PAGE * PAGE_SIZE + PAGE0_ADDRESS)
```

4.3 bootloader/bootloader.h File Reference

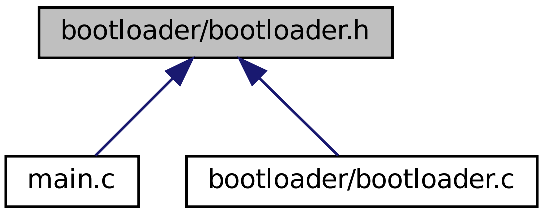
: Header file for the STM32F103C8T6 Bootloader.

```
#include "stm32f1xx_hal.h"
#include "stdio.h"
#include "stdlib.h"
#include "stdarg.h"
#include "string.h"
#include "bl_config.h"
#include "bl_typedef.h"
#include "crc.h"
#include "mbedtls/aes.h"
#include "mbedtls/sha256.h"
```

Include dependency graph for bootloader.h:



This graph shows which files directly or indirectly include this file:



Functions

- BL_STATUS BL_WriteToFlash (uint8_t page, uint8_t ∗data, uint32_t size)
- void BL_Init ()
- void BL_SendMSG (UART_HandleTypeDef ∗huart, char ∗format,...)
- BL_STATUS BL_FetchUARTCommand ()

  Fetches the UART command sent to the bootloader.
- BL_STATUS BL_Read_APPS_INFO ()
- void BL_SendAck (uint8_t ack)

  Sends an acknowledgment byte via UART.
- uint8_t BL_VerifyApplication (void)

  Verifies if an application is present and valid in memory.
- BL_STATUS BL_JumptoVerifiedAPP ()
- void BL_JumpToApplication (uint8_t app_starting_page)
- BL_STATUS BL_WriteAppsInfoToFlash (BL_INFO_t ∗info)

  Writes application info structure to flash memory.
- void Get_CurrentBL_Info (BL_INFO_t ∗dest)

  Retrieves the current bootloader information.
- uint8_t BL_InstallApplication ()

  Installs the new application from the update location in Flash memory to the application location.
- void BL_DeInit ()

  Deinitializes all peripherals used by the bootloader.

Variables

- UART_HandleTypeDef huart2
- UART_HandleTypeDef huart1
- CRC_Handle_t hcrc

4.3.1 Detailed Description

: Header file for the STM32F103C8T6 Bootloader.

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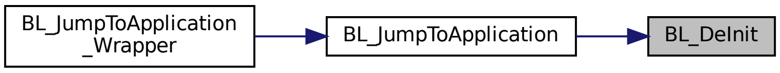
4.3.2 Function Documentation

4.3.2.1 BL_DeInit()

```
void BL_DeInit ( )
```

Deinitializes all peripherals used by the bootloader.

Here is the caller graph for this function:



4.3.2.2 BL_FetchUARTCommand()

```
BL_STATUS BL_FetchUARTCommand (
             void )
```

Fetches the UART command sent to the bootloader.

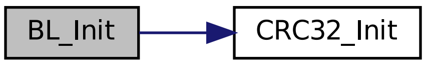
Return values

BL_STATUS	Status of the bootloader command (ACK/NACK).

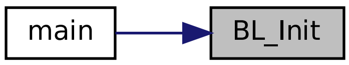
4.3.2.3 BL_Init()

```
void BL_Init ( )
```

Here is the call graph for this function:



Here is the caller graph for this function:



4.3.2.4 BL_InstallApplication()

```
uint8_t BL_InstallApplication (
            void  )
```

Installs the new application from the update location in Flash memory to the application location.

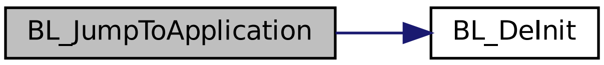
Return values

uint8← _t	Returns 0 if installation is successful, or 1 if there is an error.

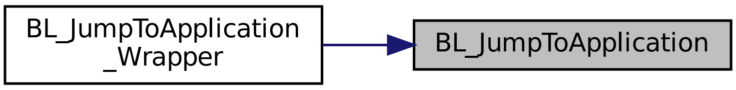
4.3.2.5 BL_JumpToApplication()

```
void BL_JumpToApplication (
            uint8_t app_starting_page )
```

Here is the call graph for this function:



Here is the caller graph for this function:



4.3.2.6 BL_JumptoVerifiedAPP()

```
BL_STATUS BL_JumptoVerifiedAPP ( )
```

4.3.2.7 BL_Read_APPS_INFO()

```
BL_STATUS BL_Read_APPS_INFO ( )
```

4.3.2.8 BL_SendAck()

```
void BL_SendAck (
             uint8_t ack )
```

Sends an acknowledgment byte via UART.

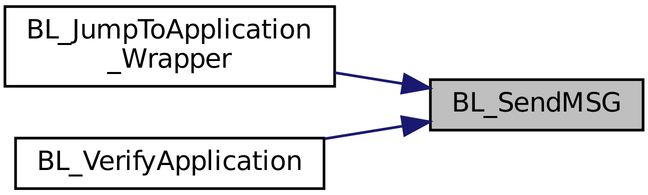
Parameters

ack	The acknowledgment byte to be sent.

4.3.2.9 BL_SendMSG()

```
void BL_SendMSG (
             UART_HandleTypeDef * huart,
             char * format,
              ...  )
```

Here is the caller graph for this function:



4.3.2.10 BL_VerifyApplication()

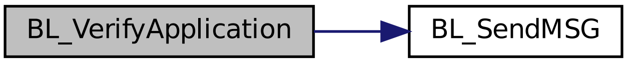
```
uint8_t BL_VerifyApplication (
            void  )
```

Verifies if an application is present and valid in memory.

Return values

uint8←_t	Status of the verification.

Here is the call graph for this function:



4.3.2.11 BL_WriteAppsInfoToFlash()

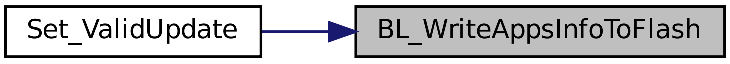
```
BL_STATUS BL_WriteAppsInfoToFlash (
            BL_INFO_t * info )
```

Writes application info structure to flash memory.

Parameters

info	Pointer to BL_INFO_t structure containing app info to write.

Here is the caller graph for this function:



4.3.2.12 BL_WriteToFlash()

```
BL_STATUS BL_WriteToFlash (
             uint8_t page,
             uint8_t * data,
             uint32_t size )
```

4.3.2.13 Get_CurrentBL_Info()

```
void Get_CurrentBL_Info (
             BL_INFO_t * dest )
```

Retrieves the current bootloader information.

Parameters

dest	Pointer to the destination structure to store bootloader info.

4.3.3 Variable Documentation

4.3.3.1 hcrc

```
CRC_Handle_t hcrc [extern]
```

4.3.3.2 huart1

```
UART_HandleTypeDef huart1 [extern]
```

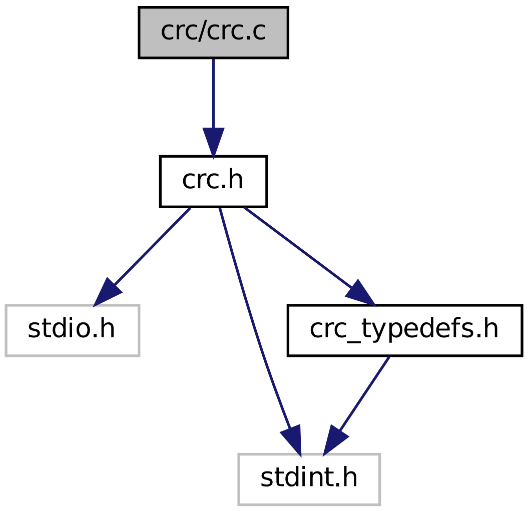
4.3.3.3 huart2

```
UART_HandleTypeDef huart2 [extern]
```

4.4 crc/crc.c File Reference

```
#include "crc.h"
```

Include dependency graph for crc.c:



Functions

- void CRC32_Init (CRC_Handle_t ∗hcrc)

  Initializes the CRC module by setting the CRC register to the initial value.
- uint32_t CRC32_Calculate (CRC_Handle_t ∗hcrc, uint8_t ∗data, uint32_t length)

  Calculates the CRC32 for the given data buffer.
- void CRC32_ResetCRC (CRC_Handle_t ∗hcrc)

  Resets the CRC register to the initial value.

4.4.1 Function Documentation

4.4.1.1 CRC32_Calculate()

```
uint32_t CRC32_Calculate (
            CRC_Handle_t * hcrc,
            uint8_t * data,
            uint32_t length )
```

Calculates the CRC32 for the given data buffer.

Parameters

hcrc	Pointer to the CRC handle structure, which contains the CRC configuration and state.
data	Pointer to the data buffer for which the CRC is to be calculated.
length	Length of the data buffer.

Return values

The	computed CRC32 value.

4.4.1.2 CRC32_Init()

```
void CRC32_Init (
            CRC_Handle_t * hcrc )
```

Initializes the CRC module by setting the CRC register to the initial value.

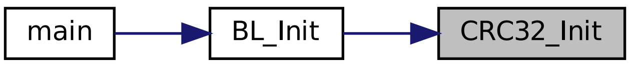
Parameters

hcrc	Pointer to the CRC handle structure, which contains the CRC configuration.

Return values

The	initial CRC value set in the CRC register.

Here is the caller graph for this function:



4.4.1.3 CRC32_ResetCRC()

```
void CRC32_ResetCRC (
            CRC_Handle_t * hcrc )
```

Resets the CRC register to the initial value.

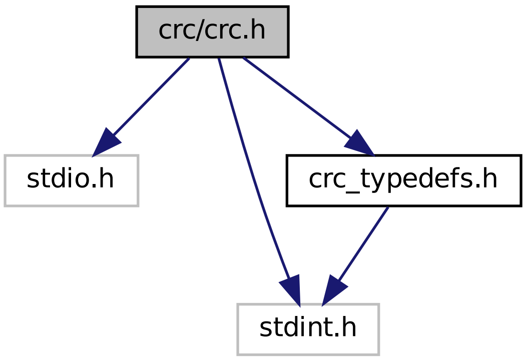
Parameters

hcrc	Pointer to the CRC handle structure.

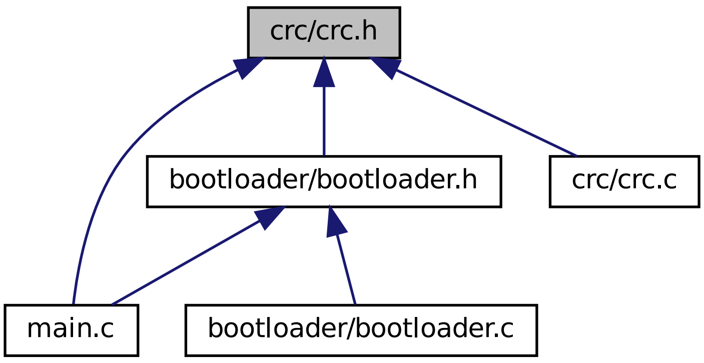
4.5 crc/crc.h File Reference

```
#include <stdio.h>
#include <stdint.h>
#include "crc_typedefs.h"
```

Include dependency graph for crc.h:



This graph shows which files directly or indirectly include this file:



Functions

- void CRC32_Init (CRC_Handle_t ∗hcrc)

    Initializes the CRC module by setting the CRC register to the initial value.
- uint32_t CRC32_Calculate (CRC_Handle_t ∗hcrc, uint8_t ∗data, uint32_t length)

    Calculates the CRC32 for the given data buffer.
- void CRC32_ResetCRC (CRC_Handle_t ∗hcrc)

    Resets the CRC register to the initial value.

4.5.1 Function Documentation

4.5.1.1 CRC32_Calculate()

```
uint32_t CRC32_Calculate (
            CRC_Handle_t ∗ hcrc,
            uint8_t ∗ data,
            uint32_t length )
```

Calculates the CRC32 for the given data buffer.

Parameters

hcrc	Pointer to the CRC handle structure, which contains the CRC configuration and state.
data	Pointer to the data buffer for which the CRC is to be calculated.
length	Length of the data buffer.

Return values

The	computed CRC32 value.

4.5.1.2 CRC32_Init()

```
void CRC32_Init (
            CRC_Handle_t * hcrc )
```

Initializes the CRC module by setting the CRC register to the initial value.

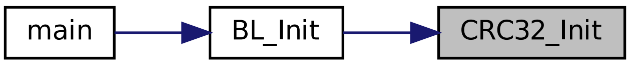
Parameters

hcrc	Pointer to the CRC handle structure, which contains the CRC configuration.

Return values

The	initial CRC value set in the CRC register.

Here is the caller graph for this function:



4.5.1.3 CRC32_ResetCRC()

```
void CRC32_ResetCRC (
            CRC_Handle_t * hcrc )
```

Resets the CRC register to the initial value.

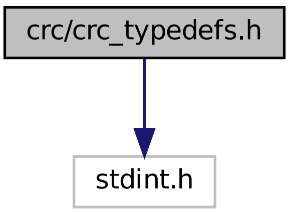
Parameters

hcrc	Pointer to the CRC handle structure.

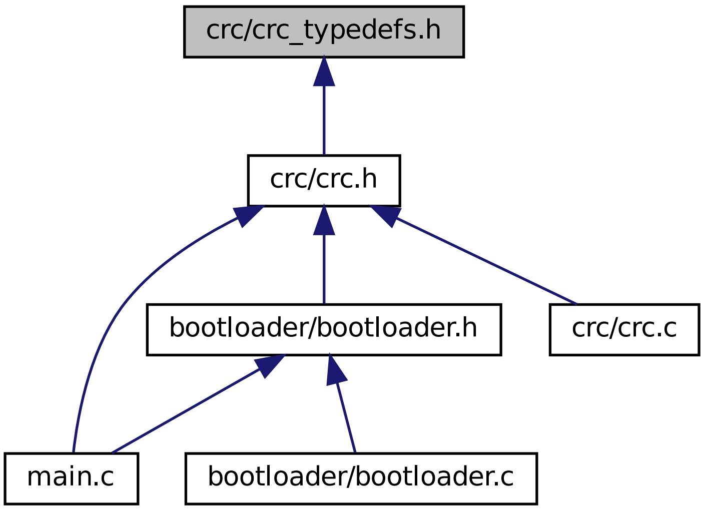
4.6 crc/crc_typedefs.h File Reference

`#include <stdint.h>`

Include dependency graph for crc_typedefs.h:



This graph shows which files directly or indirectly include this file:



Classes

- struct CRC_Handle_t

Macros

- #define DEFAULT_POLY_VAL 0xEDB88320
- #define DEFAULT_INIT_VAL 0xFFFFFFFF

4.6.1 Macro Definition Documentation

4.6.1.1 DEFAULT_INIT_VAL

```
#define DEFAULT_INIT_VAL 0xFFFFFFFF
```

4.6.1.2 DEFAULT_POLY_VAL

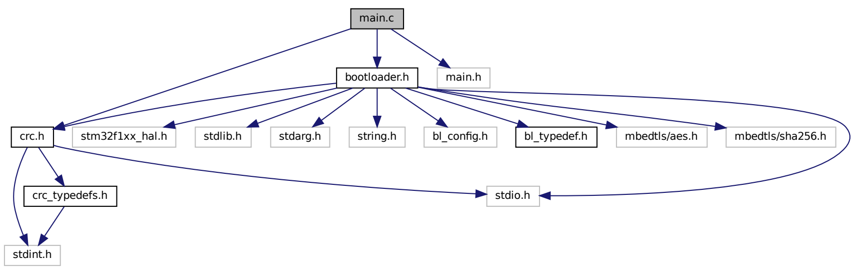
```
#define DEFAULT_POLY_VAL 0xEDB88320
```

4.7 main.c File Reference

: Main program body

```
#include "crc.h"
#include "bootloader.h"
#include "main.h"
```

Include dependency graph for main.c:



Functions

- void SystemClock_Config (void)

  System Clock Configuration.
- int main (void)

  The application entry point.
- void Error_Handler (void)

  This function is executed in case of error occurrence.

Variables

- CRC_Handle_t hcrc
- UART_HandleTypeDef huart1
- UART_HandleTypeDef huart2
- BL_INFO_t ∗ bl_info_ptr

4.7.1 Detailed Description

: Main program body

Attention

4.7.2 Function Documentation

4.7.2.1 Error_Handler()

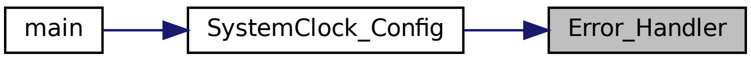
```
void Error_Handler (
             void  )
```

This function is executed in case of error occurrence.

Return values

None	

Here is the caller graph for this function:



4.7.2.2 main()

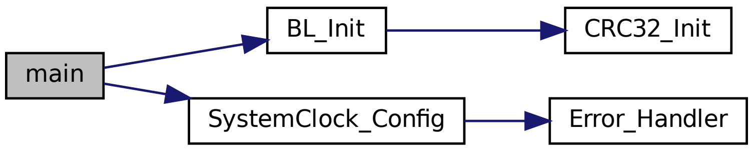
```
int main (
             void  )
```

The application entry point.

Return values

int	

Here is the call graph for this function:



4.7.2.3 SystemClock_Config()

```
void SystemClock_Config (
            void  )
```

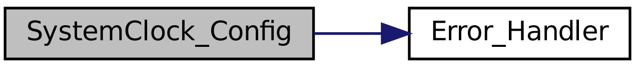
System Clock Configuration.

Return values

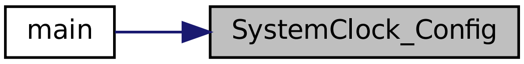
None	

Initializes the RCC Oscillators according to the specified parameters in the RCC_OscInitTypeDef structure.

Initializes the CPU, AHB and APB buses clocksHere is the call graph for this function:



Here is the caller graph for this function:



4.7.3 Variable Documentation

4.7.3.1 bl_info_ptr

```
BL_INFO_t* bl_info_ptr  [extern]
```

4.7.3.2 hcrc

```
CRC_Handle_t hcrc
```

4.7.3.3 huart1

```
UART_HandleTypeDef huart1
```

4.7.3.4 huart2

```
UART_HandleTypeDef huart2
```

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