UM0097
User manual

STR71x firmware library

Introduction

About this manual

This document is the STR71x firmware library user manual. It describes the STR71x peripheral firmware library: a collection of routines, data structures and macros that cover the features of each peripheral.

The firmware library user manual is structured as follows:

- Definitions, document conventions and firmware library rules
- Overview of the firmware library (package content, library structure), installation guidelines, and examples of how to use the library.
- Detailed description the firmware library: configuration structure and function descriptions for each peripheral in detail.

About STR71x firmware library

The STR71x firmware library is a firmware package consisting of device drivers for all standard STR71x peripherals. You can use any STR71x device in applications without in-depth study of each peripheral specification. As a result, using this library can save you a lot of the time that you would otherwise spend in coding and also the cost of developing and integrating your application.

Each device driver consists of a set of functions covering the functionality of the peripheral. Since all the STR71x peripherals and their corresponding registers are memory-mapped, a peripheral can be easily controlled using ‘C’ code. The source code, developed in ‘C’, is fully documented. A basic knowledge of ‘C’ programming is required.

The library contains a complete firmware in ‘C’ and it is independent from any software tool-chains. Only the start-up files are tool-chain dependent.

Since the library is generic and covers all of the capabilities of each peripheral, it may not be as efficient as it could be from a code size and/or execution speed point of view. For many applications the library may be used as is. However, for applications with strong constraints in terms of code size and/or execution speed, the library drivers should be used as a reference, to show you how to configure the peripheral and which you can then tailor to your specific application requirements.

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1 Document and library rules

The user manual and the firmware library use the conventions described in the sections below.

1.1 Abbreviations

Table 1 describes the different abbreviations used in this document.

Table 1. List of acronyms

Acronym	Peripheral / Unit
ADC12	12-bit Analog to Digital Converter
APB	Advanced Peripheral Bus bridges
BSPI	Buffered Serial Peripheral Interface
CAN	Controller Area Network
TIM	Timer
EIC	Enhanced Interrupt Controller
XTI	External Interrupts
EMI	External Memory Interface
FLASH	Embedded Flash
GPIO	General Purpose Input Output
I2C	Inter-Integrated Circuit
PCU	Power Control Unit
RCCU	Reset & Clock Control Unit
RTC	Real Time Clock
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
WDG	Watchdog Timer

1.2 Styles and symbols

The firmware library uses the following style conventions:

- Program listings, program examples, structure definitions and function prototypes are shown in a special typeface. This example is a function prototype shown in `courier typeface`.

```
int PPP_Config (int * pPointer);
```

- Program portions, variables and function names quoted in a paragraph are in *italic typeface*. For example

bVariable is used as local variable in the function *PPP_Config*.

- A comment in a program listing is shown in *italic typeface.* For example:

```
int PPP_Config (int * pPointer); /*this is a comment */
```

1.3 Naming conventions

The Firmware Library uses the following naming conventions:

- ***PPP*** is used to reference to any peripheral acronym, e.g. ***ADC***. See the section above for more information on peripheral acronyms.
- System and source/header file names must be preceded by '*71x_*', e.g. *71x_conf.h*, except driver source code and header files for *PPP* peripheral, e.g. *71x_tim.h*. Only lower case letters, digits, underscore and at most one suffix are allowed in filenames.
- Constants used in one file are defined at the head of that file. A constant used in more than one file should be defined in a header file. All constants use upper case characters.
- Registers are considered as constants. Their names are in upper case letters and have in most case the same acronyms as in the STR71x reference manual document.
- Variable names are preceded with a letter which indicates the type/size of the variable (b:8 bits, w: 16 bits, d: 32 bits, p: pointer). The variables are in lower case and each word begins with an upper case, e.g. *bVariable*, *pPointer*.
- Peripheral function names are preceded with the corresponding peripheral acronym in upper case followed by an underscore. The first letter in each word is upper case, e.g. ***EIC_CurrentIRQChannelValue***. Only one underscore is allowed in a function name to separate the peripheral acronym from the rest of the function name.
- Functions declared locally don't have any prefix.
- Functions used to initialize a peripheral are named ***PPP_Init***, e.g. ***PCU_Init***.
- Functions for checking whether the specified PPP flag is set or not end with *status*, e.g. ***TIM_FlagStatus***.
- Functions used to configure a peripheral functionality end with *config*, e.g. ***WDG_PrescalerConfig***. Functions that configure a peripheral interrupt are called ***PPP_ITConfig***.
- Functions performing a specific action have a name that ends with a verb describing that action, e.g. activate, clear, send, write...
- Functions clearing specific peripheral flags are called ***PPP_FlagClear***.

1.4 C coding rules

The following rules are used in the Firmware Library.

- 12 generic types are defined for variables whose type and size are fixed, and are typically used for register access. These types are defined in the file *71x_type.h*:

```
typedef unsigned long   u32;
typedef unsigned short u16;
typedef unsigned char   u8;

typedef signed long   s32;
typedef signed short s16;
typedef signed char   s8;

typedef volatile unsigned long   vu32;
typedef volatile unsigned short vu16;
typedef volatile unsigned char   vu8;
```

```
typedef volatile signed long   vs32;
typedef volatile signed short vs16;
typedef volatile signed char   vs8;
```

- ***bool*** type is defined in the file ***71x_type.h*** as:

```
typedef enum
{
  FALSE = 0,
  TRUE  = !FALSE
} bool;
```

- ***FlagStatus*** type is defined in the file ***71x_type.h***. Two values can be assigned to this variable: ***SET*** or ***RESET***.

```
typedef enum
{
  RESET = 0,
  SET   = !RESET
} FlagStatus;
```

- ***FunctionalState*** type is defined in the file ***71x_type.h***. Two values can be assigned to this variable: ***ENABLE*** or ***DISABLE***.

```
typedef enum
{
  DISABLE = 0,
  ENABLE  = !DISABLE
} FunctionalState;
```

- Pointers to peripherals are used to access the peripheral control registers. Peripheral pointers point to data structures that represent the mapping of the peripheral control registers. A structure should be defined for each peripheral in ***71x_map.h*** file. The example below illustrates the ***GPIO*** register structure declaration:

```
typedef volatile struct
{
  vu16 PC0;
  vu16 EMPTY1;
  vu16 PC1;
  vu16 EMPTY2;
  vu16 PC2;
  vu16 EMPTY3;
  vu16 PD;
} GPIO_TypeDef;
```

Register names are the register acronyms written in upper case for each peripheral. *EMPTYi* (*i* is an integer that indexes the reserved field) replaces a reserved field and is never used.

Sometimes an enumeration is needed for a peripheral. This enumeration is called *PPP_Registers* and is declared in the file *71x_ppp.h*, e.g.:

```
typedef enum
{
  GPIO_PC0 = 0x00,
  GPIO_PC1 = 0x04,
  GPIO_PC2 = 0x08,
  GPIO_PD  = 0x0C,
} GPIO_Registers;
```

Peripherals are declared in ***71x_map.h*** file. This example shows the declaration of the *GPIO* peripheral:

```
#ifndef EXT
  #define EXT extern
#endif
...

/* APB2 Base Address definition */
#define APB2_BASE 0xE0000000

#define GPIO0_BASE      (APB2_BASE + 0x3000)
#define GPIO1_BASE      (APB2_BASE + 0x4000)

/* GPIO0 and GPIO1 peripherals declaration */
#ifndef DEBUG

...
#ifdef _GPIO0
  #define GPIO0               ((GPIO_TypeDef *)GPIO0_BASE)
#endif /*GPIO0*/

#ifdef _GPIO1
  #define GPIO1               ((GPIO_TypeDef *)GPIO1_BASE)
#endif /*GPIO1*/
...
#else /* DEBUG */

#ifdef _GPIO0
    EXT GPIO_TypeDef          *GPIO0;
#endif /*GPIO0*/

#ifdef _GPIO1
    EXT GPIO_TypeDef          *GPIO1;
#endif /*GPIO1*/

...
#endif  /* DEBUG */
```

To enter debug mode you have to define the label *DEBUG* in ***71X_conf.h*** file. Debug mode allows you to watch the peripheral registers in a debugger window, but it uses up some additional memory space and makes the code less efficient. In both cases *GPIO0* is a pointer to the first address of *GPIO0* port.

EXT variable is defined in the file ***71x_lib.c*** as follows:

```
#define EXT
```

DEBUG mode is initialized as follows in the ***71x_lib.c*** file:

```
#define DEBUG
#ifdef DEBUG
  void debug(void)
  {
#ifdef _GPIO0
  GPIO0 = (GPIO_TypeDef *)GPIO0_BASE;
#endif
```

```
#ifdef _GPIO1
  GPIO1 = (GPIO_TypeDef *)GPIO1_BASE;
#endif

#ifdef _GPIO2
  GPIO2 = (GPIO_TypeDef *)GPIO2_BASE;
#endif
    ...
  }
#endif /* DEBUG */
```

Note: Debug mode increases the code size and reduces the code performance. For this reason, it is recommended to use it only when debugging the application and to remove it from the final application code.

Each peripheral has several dedicated registers which contain different flags. Registers are defined within a dedicated structure for each peripheral. Flag definition is adapted to each peripheral case (defined in ***71x_ppp.h*** file). Flags are defined as acronyms written in upper case and prefixed by '*PPP_*' prefix, *PPP* is the acronym of the corresponding peripheral. The flags of each peripheral are included in an enumeration named *PPP_Flags*. Some peripherals adopt this naming convention.

Each flag label is defined as a byte divided into two parts:

– The 3 MSB bits are allocated to identify the register to which the flag belongs (it is possible to number registers from 0 to 7).

– The 5 LSB bits are allocated to identify the flag position in the register to which it belongs (it is possible to number flags from 0 to 31).

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Register			Bit position				

The following gives an example of flag definitions:

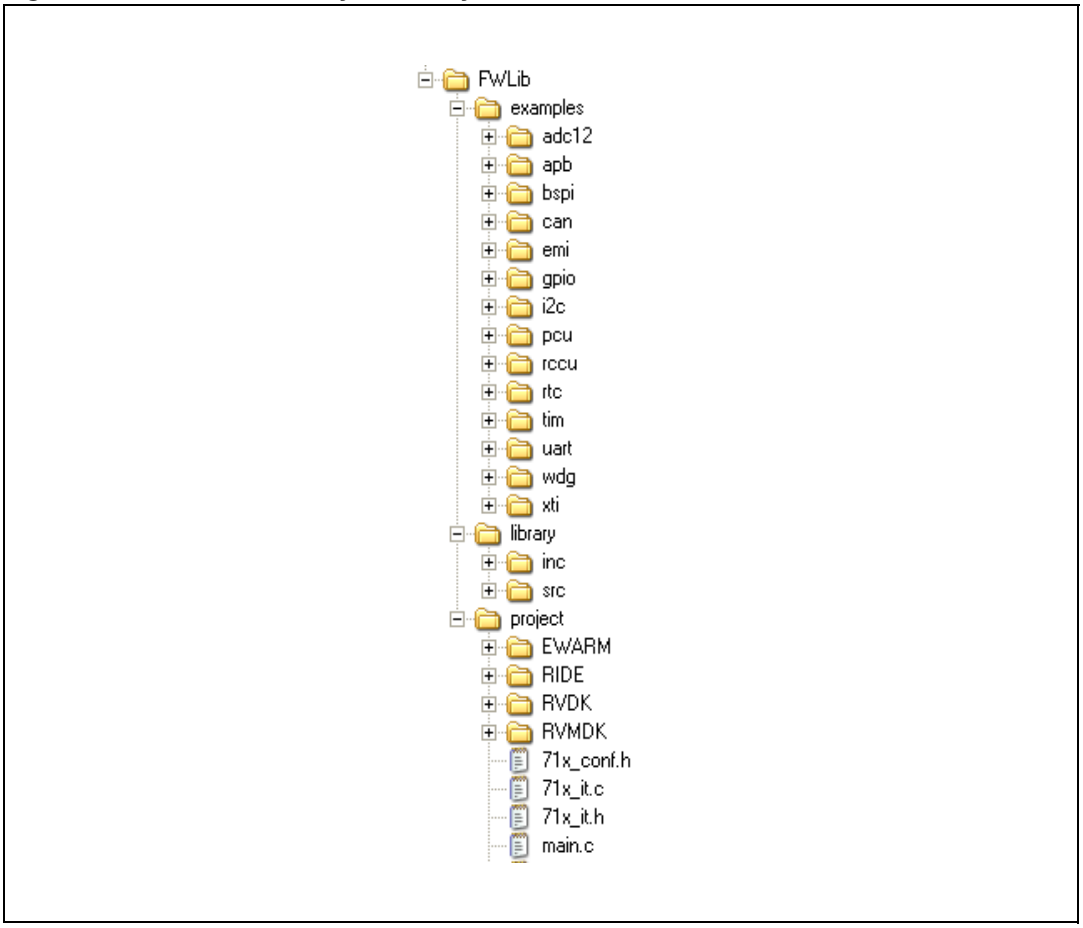
```
typedef enum
{
  APB_APBT  = 0x26,
  APB_OUTM  = 0x25,
  APB_ABORT = 0x21,
  APB_ABTEN = 0x49,
  APB_OMnRW = 0x68,
  APB_TOnRW = 0x88
} APB_Flags;
```

2 Firmware library

2.1 Package description

The firmware library is supplied in one single zip package. The extraction of the zip file will give the one folder ***"STR71xFWLib\FWLib"*** containing the following sub-directories:

Figure 1. Firmware library directory structure



2.1.1 Examples

This directory contains for each peripheral sub-directory, the minimum set of files needed to run a typical example on how to use a peripheral:

- ***Readme.txt***: a brief text file describing the example and how to make it work
- ***71x_conf.h:*** the header file to configure used peripherals and miscellaneous defines
- ***71x_it.c***: the source file containing the interrupt handlers (the function bodies may be empty if not used)
- ***71x_it.h***: header file including all interrupt handler prototypes
- ***main.c***: the example program

Note: All examples are independent from any software toolchain and running on STMicroelectronics STR71x-EVAL board and can be easily tailored to any other hardware.

2.1.2 Library

This directory contains all the subdirectories and files that form the core of the library:

- ***inc*** sub-directory contains the firmware library header files that do not need to be modified by the user:
  - ***71x_type.h***: Contains the common data types and enumeration used in all other files
  - ***71x_map.h***: Contains the peripherals memory mapping and registers data structures
  - ***71x_lib.h***: Main header file including all other headers
  - ***71x_ppp.h*** (one header file per peripheral): contains the function prototypes, data structures and enumeration
- ***src*** sub-directory contains the firmware library source files that do not need to be modified by the user:
  - ***71x_ppp.c*** (one source file per peripheral): contains the function bodies of each peripheral

Note: All library files are coded in Strict ANSI-C and are independent from any firmware toolchain.

2.1.3 Project

This directory contains a standard template project program that compiles all library files and also all the user modifiable files needed to create a new project:

- ***71x_conf.h***: The configuration header file with all peripherals defined by default
- ***71x_it.c***: The source file containing the interrupt handlers (the function bodies are empty in this template)
- ***71x_it.h***: header file including all interrupt handlers prototypes
- ***main.c***: The main program body
- ***EWARM***, ***RVDK***, ***RVMDK***, ***RIDE***: For each toolchain usage, refer to Readme.txt file available in the same sub-directory

2.2 File description

Several files are used in the firmware library. *Table 2* enumerates and describes the different files used in the firmware library.

Table 2. Source/header file list

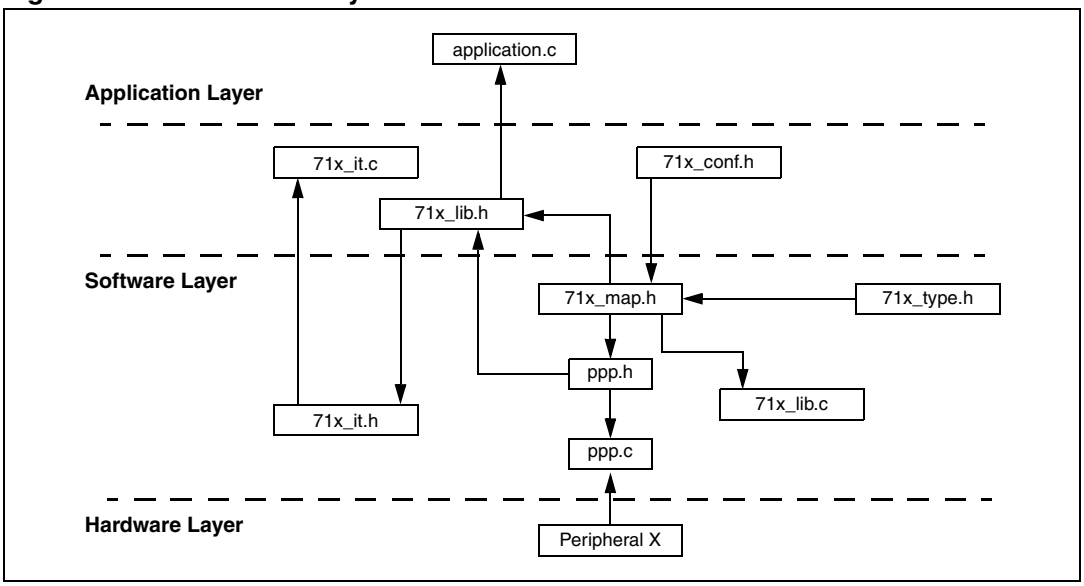
Filename	Description
71x_conf.h	Parameter configuration file. It should be modified by the user to specify several parameters to interface with the library before running any application. You can enable or disable peripherals if you use the template and you can also change the value of your external crystal oscillator value. Using this file you can select to compile the library in DEBUG or RELEASE mode.
main.c	The main example program body.

Table 2. Source/header file list (continued)

Filename	Description
71x_it.c	Peripheral interrupt functions file. It is modified by you by including the interrupt functions code used in your application. In case of multiple interrupt requests mapped on the same interrupt vector, the function performs a polling on interrupt flags contained inside the peripheral in order to establish the exact source of the interrupt. The names of these functions are already provided in the firmware library.
71x_it.h	Header file including the definition of interrupt functions.
71x_lib.c	Debug mode initialization file. It includes the definition of variable pointers pointing each one to the first address of the dedicated peripheral and the definition of one function called when you choose to enter in debug mode. This function initializes the defined pointers.
71x_lib.h	Header file including all the peripherals' header files. It is the unique file to be included in the user application to interface with the library.
71x_map.h	This file implements memory mapping and physical registers address definition for both development and debug modes. This file is supplied with all peripherals.
71x_type.h	Common declarations file. It includes common types and constants which are used by all peripheral drivers.
71x_ppp.c	Driver source code file of the PPP peripheral written in C language.
71x_ppp.h	Header file of the PPP peripheral. It includes the functions prototypes, data structures and enumerations used by the driver and also available for the user.

Figure 2 shows the firmware library architecture and file inclusion relationships.

Figure 2. Firmware library file structure



For each peripheral a source code file *71x_ppp.c* and a header file *71x_ppp.h* are provided.

- the *71x_ppp.c* file contains all the firmware functions required to use the peripheral
- the *71x_ppp.h* file contains all the functions prototypes, data structures, data types and enumeration needed. It contains also the inline functions code, if any.

One memory mapping file *71x_map.h* is supplied for all peripherals. This file contains all the register declarations for both development and debug modes.

The header file *71x_lib.h* includes all the peripheral header files. This is the only file that has to be included in the user application to interface with the library.

You can modify the *71x_conf.h* to define which peripherals need to be included in the application to make it run.

Other files are also provided: *71x_it.h* and *71x_it.c*. These files contain all the firmware functions required to handle the STR71x interrupts.

If you want to handle an interrupt routine, you should modify the appropriate function in the file *71x_it.c* (the body of each function is empty by default).

Note: Only the 71x_conf.h and 71x_it.c files should be modified to link the application with the library.

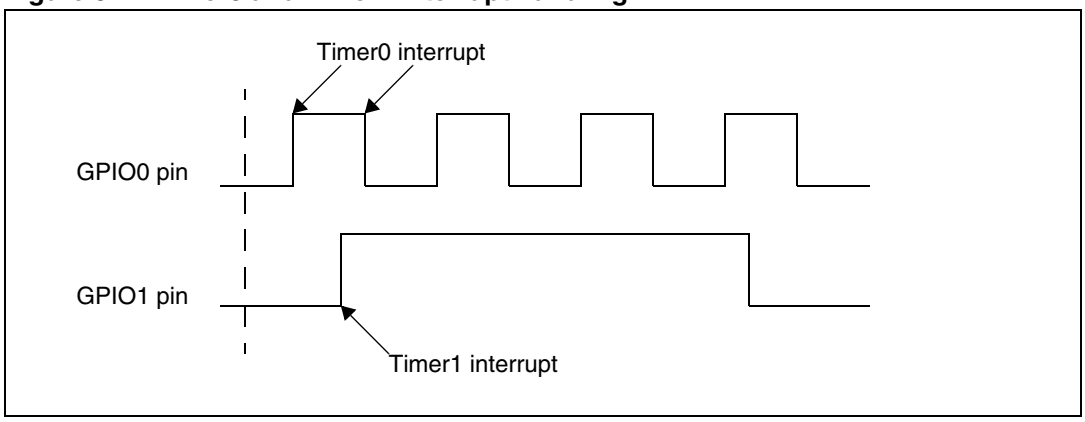
2.3 How to use the STR71x library

This section describes how to implement an application using the STR71x firmware library.

Example: The application initializes and starts two timer overflow interrupts. When a timer expires, an interrupt, handled in *71x_it.c*, is generated. Timer 0 generates an overflow interrupt every 130 ms and toggles the *GPIO0* pin level on/off. Timer 1 is configured to generate an interrupt every 2.1s and to set *GPIO1* pin to high level for 1.05 s. The chip is clocked by an external oscillator at a frequency of 16 MHz.

Timer 0 interrupt priority is set to be higher than Timer 1 interrupt priority to allow the Timer 0 *T0TIMI_IRQHandler* interrupt routine to be served during the execution of the Timer 1 interrupt routine. The following figure shows the behavior of the *GPIO0* and *GPIO1* pins and Timer 0 and Timer 1 interrupts.

Figure 3. Timer0 and Timer1 interrupt handling



The following steps explain how to use the STR71x library to build the user application

- Edit the *71x_conf.h* file and uncomment the *_GPIO* and *_TIM* labels, this allows you to include the firmware libraries of the *GPIO* and the *TIM* peripherals in your firmware. Uncomment the *_GPIO0*, *_GPIO1, _TIM0* and *_TIM1* labels to be able to access the peripheral registers. Uncomment the DEBUG label, this allows you to see the peripheral registers content in the watch window.

```
#ifndef __71x_CONF_H
#define __71x_CONF_H
#define DEBUG
...
#define _TIM  /*to include the TIM library*/
#define _TIM0 /*to access the TIM0 registers*/
#define _TIM1 /*to access the TIM1 registers*/
...
#define _GPIO  /*to include the GPIO library*/
#define _GPIO0 /*to access the GPIO0 registers*/
#define _GPIO1 /*to access the GPIO1 registers*/
...
#endif /* __71x_CONF_H */
```

- Edit the file *71x_it.c* and add the following code to the Timer 0 interrupt handler routine *T0TIMI_IRQHandler*:

```
void T0TIMI_IRQHandler (void)
{
TIM_FlagClear(TIM0, TIM_TOF); /* to clear the TIM0 interrupt
flag */
GPIO_WordWrite(GPIO0, ~GPIO_WordRead(GPIO0)); /* invert the
GPIO0 output level */
}
```

- Add the following code to the Timer 1 interrupt handler routine *T1TIMI_IRQHandler*:

```
void T1TIMI_IRQHandler (void)
{
 u32 i;
 TIM_FlagClear(TIM1, TIM_TOF); /*to clear the TIM1 interrupt
flag */
 GPIO_WordWrite(GPIO1, ~GPIO_WordRead(GPIO1));
 for (i=0; i<0x000FFFFF; i++); /* delay */
 GPIO_WordWrite(GPIO1, ~GPIO_WordRead(GPIO1));
}
```

- The initialization of the *GPIO0*, *GPIO1*, *TIM0* and *TIM1* peripherals is done in the application source file, *main.c* in our case. The configuration of the *EIC* and the *IRQ* channels priority is also done in this file.
- Edit the *main.c* file and add the following code:

```
#include “71x_lib.h“
int main(void)
{

  #ifdef DEBUG
    debug();
  #endif

/*EIC configuration*/
 /*Set Timer 0 interrupt channel priority level to 2*/
 EIC_IRQChannelPriorityConfig(T0TIMI_IRQChannel,2);
 /*Enable Timer 0 IRQ channel interrupts*/
 EIC_IRQChannelConfig(T0TIMI_IRQChannel,ENABLE);

 /* Set Timer 1 interrupt channel priority level to 1*/
```

```
 EIC_IRQChannelPriorityConfig(T1TIMI_IRQChannel,1);
 /* Enable Timer 1 IRQ channel interrupts*/
 EIC_IRQChannelConfig(T1TIMI_IRQChannel,ENABLE);

/*configure GPIO0 pins as push-pull output mode*/
 GPIO_Config(GPIO0, 0xFFFF, GPIO_OUT_PP);
/* Set GPIO0 pins to low level*/
 GPIO_WordWrite(GPIO0, 0x0000);

/* configure GPIO1 pins as push-pull output mode*/
 GPIO_Config(GPIO1, 0xFFFF, GPIO_OUT_PP);
/* Set GPIO1 pins to low level*/
 GPIO_WordWrite(GPIO1, 0x0000);

/*Timer 0 Configuration*/
 //*Initialize the Timer*/
 TIM_Init (TIM0);
 /*Configure Timer 0 Prescaler*/
 TIM_PrescalerConfig (TIM0,0x0F);
 /* Enable Timer 0 Overflow Interrupt*/
 TIM_ITConfig(TIM0,TIM_TO_IT,ENABLE);

/* Timer 1 Configuration*/
 /* Initialize the Timer*/
 TIM_Init (TIM1);
/* Configure Timer 1 Prescaler*/
 TIM_PrescalerConfig (TIM1,0xFF);
/* Enable Timer 1 Overflow Interrupt*/
 TIM_ITConfig(TIM1,TIM_TO_IT,ENABLE);

 /* Enable IRQ interrupts*/
 EIC_IRQConfig(ENABLE);
 /* Start Timer 0*/
 TIM_CounterConfig (TIM0,TIM_START);
 /* Start Timer 1*/
 TIM_CounterConfig (TIM1,TIM_START);
/*Infinite loop*/
 while(1);
}
```

3 Peripheral firmware overview

This chapter describes in detail each peripheral firmware library. The related functions are fully documented. An example of use of the function is given and some important considerations to take into account to avoid failure are also provided.

This chapter describes each peripheral firmware library in detail. The related functions are fully documented. An example of use of the function is given and some important considerations to take into account to avoid failure are also provided.

Table 3 describes peripheral firmware functions.

Table 3. Peripheral firmware functions

Function name	Description
Function prototype	Prototype declaration
Behavior Description	Brief explanation of how the functions are executed
Input Parameter {x}	Description of the input parameters
Output parameter {x}	Description of the output parameters
Return Value	Value returned by the function
Required Preconditions	Conditions required before calling the function
Called Functions	Other library functions called by the function
See also	Related functions for reference

3.1 Power control unit (PCU)

The PCU driver may be used for a variety of purposes, including power management configuration and low power mode selection.

The first section describes the data structures used in the PCU firmware library. The second section presents the PCU firmware library functions.

3.1.1 Data structures

PCU register structure

The *PCU* register structure *PCU_TypeDef* is defined in the *71x_map.h* file as follows:

```
typedef volatile struct
{
  vu16 MDIVR;
  u16 EMPTY1;
  vu16 PDIVR;
  u16 EMPTY2;
  vu16 RSTR;
  u16 EMPTY3;
  vu16 PLL2CR;
  u16 EMPTY4;
  vu16 BOOTCR;
  u16 EMPTY5;
```

```
  vu16 PWRCR;
u16  EMPTY6;
} PCU_TypeDef;
```

Table 4 describes the *PCU* structure fields:

Table 4. PCU structure fields

Register	Description
MDIVR	*CPU* frequency division factor
PDIVR	*APB* frequency division factor
RSTR	Peripheral Reset Control Register
PLL2CR	*PLL2* Control Register
BOOTCR	Boot Configuration Register
PWRCR	Power Control Register

The *PCU* peripheral is declared in the same file:

```
...
#define PCU_BASE   0xA0000040
...
#ifndef DEBUG
  ...
#ifdef _PCU
  #define PCU                  ((PCU_TypeDef *)PCU_BASE)
#endif /*PCU*/
...
#else   /* DEBUG */
  ...
#ifdef _PCU
    EXT PCU_TypeDef           *PCU;
#endif /*PCU*/

  ...
#endif
```

When debug mode is used, *PCU* pointer is initialized in the file *71x_lib.c*:

```
#ifdef _PCU
  #define PCU                  ((PCU_TypeDef *)PCU_BASE)
#endif /*PCU*/
```

In debug mode, *_PCU* must be defined, in the file *71x_conf.h*, to access the peripheral registers as follows:

```
#define _PCU
```

Some *PCU* functions use the *RCCU* and the *XTI* registers and functions, *_RCCU* and *_XTI* must be defined in *71x_conf.h* file to make the *RCCU* and the *XTI* functions accessible:

```
#define _RCCU
#define _XTI
```

Voltage regulator status

The following enumeration defines the states of the voltage regulator. The *VR_Status* enumeration is defined in the file *71x_pcu.h*:

```
typedef enum
{
  PCU_STABLE,
  PCU_UNSTABLE
} PCU_VR_Status;
```

Table 5 describes the status of *PCU* voltage regulator.

Table 5. PCU voltage regulator status

Regulator State	Description
PCU_STABLE	The Main Voltage Regulator is stable and can be used to power the device.
PCU_UNSTABLE	The Main Voltage Regulator is not yet stable

PCU voltage regulators

The following enumeration defines the power control unit voltage regulators. The *PCU_VR* enumeration is declared in the file *71x_pcu.h*:

```
typedef enum
{
  PCU_MVR = 0x0008,
  PCU_LPR = 0x0010
} PCU_VR;
```

Table 6 describes the *PCU* voltage regulators.

Table 6. PCU voltage regulator descriptions

Voltage Regulators	Description
PCU_MVR	The Main Voltage Regulator
PCU_LPR	The Low Power Voltage Regulator

WFI clocks

The following enumeration defines the *WFI* mode clocks. *WFI_CLOCKS* enumeration is declared in the file *71x_pcu.h*:

```
typedef enum
{
  WFI_CLOCK2_16,
  WFI_Ck_AF
} WFI_CLOCKS;
```

Table 7 lists the different *WFI* Clocks.

Table 7. WFI clocks

WFI Clocks	Description
WFI_CLOCK2_16	CLOCK2/16 clock is selected during LPWFI
WFI_Ck_AF	The RTC clock is selected during LPWFI

PCU flags

The following enumeration defines the *PCU* flags. *PCU_Flags* enumeration is defined in the file *71x_pcu.h*:

```
typedef enum
{
  PCU_WREN = 0x8000,
  PCU_VROK = 0x1000
} PCU_Flags;
```

Table 8 lists the different PCU flags.

Table 8. PCU flags

PCU Flags	Description
PCU_WREN	Power Control Unit register Write Enable flag
PCU_VROK	Main Voltage Regulator OK flag

3.1.2 Firmware library functions

Table 9 enumerates the different functions of the *PCU* library.

Table 9. PCU library functions

Function Name	Description
PCU_MVRStatus	Reads and returns the *PCU* main voltage regulator status
PCU_FlagStatus	Reads and returns the status of a specified *PCU* flag
PCU_VRConfig	Configures (Enables / Disables) the *PCU* voltage regulators
PCU_VRStatus	Reads and returns the *PCU* voltage regulator status
PCU_LVDDisable	Disables the Low Voltage Detector
PCU_LVDStatus	Reads and returns the *LVD* status
PCU_LPModesConfig	Configures the different STR71x low power mode options
PCU_WFI	Used to enter WFI and LPWFI modes
PCU_STOP	Used to enter STOP mode
PCU_STANDBY	Used to enter STANDBY mode
PCU_FlashBurstCmd	This routine is used to set the FLASH to LP/BURST mode
PCU_32OSCCmd	This routine is used to enable/disable the 32 kHz oscillator

PCU_MVRStatus

Function Name	PCU_MVRStatus
Function Prototype	PCU_VR_Status PCU_MVRStatus (void);
Behavior Description	This routine checks and returns the main voltage regulator stability status.
Input Parameter	None
Output Parameter	None
Return Value	The stability status of the Main Voltage Regulator. Refer to *Voltage regulator status on page 19* for more details on the allowed values of this parameter.
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to check the main voltage regulator status:

```
{
...
PCU_VR_Status MainVR_Status;
 MainVR_Status = PCU_MVRStatus ();
...
}
```

PCU_FlagStatus

Function Name	PCU_FlagStatus
Function Prototype	FlagStatus PCU_FlagStatus (PCU_Flags Xflag);
Behavior Description	This routine is used to check the status of the specified *PCU* flag.
Input Parameter	*Xflag*: specifies the *PCU* flag. Refer to *PCU flags on page 20* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	The specified flag status: – *SET*: The *PCU* flag is set. – *RESET*: The *PCU* flag is reset.
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to check the *PCU* flag status.

```
{
 FlagStatus WREN_Status;
 FlagStatus VROK_Status;
  ..
 /* WREN_Status holds the WEN flag status */
 WREN_Status = PCU_FlagStatus (PCU_WREN);
```

```
 /* VROK_Status holds the Main VR_OK flag status */
 VROK_Status = PCU_FlagStatus (PCU_VROK);
...
}
```

PCU_VRConfig

Function Name	PCU_VRConfig
Function Prototype	`void PCU_VRConfig(PCU_VR Xvr, FunctionalState NewState);`
Behavior Description	This routine is used to configure (enable / bypass) the *PCU* voltage regulators.
Input Parameter 1	*Xvr*: Specifies the *PCU* voltage regulator. Refer to *PCU voltage regulators on page 19* for more details on the allowed values of this parameter.
Input Parameter 2	*NewState*: Specifies whatever the corresponding voltage regulator is enabled or bypassed. – *ENABLE*: Enable the corresponding *PCU* voltage regulator – *DISABLE*: Bypass the corresponding *PCU* voltage regulator
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to bypass the main voltage regulator.

```
{
...
 PCU_VRConfig(PCU_MVR, DISABLE);
...
}
```

PCU_LVDDisable

Function Name	PCU_LVDDisable
Function Prototype	`void PCU_LVDDisable (void);`
Behavior Description	This routine is used to disable the Low Voltage Detector.
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to disable the *LVD* feature.

```
{
...
 PCU_LVDDisable ();
...
}
```

PCU_VRStatus

Function Name	PCU_VRStatus
Function Prototype	`FunctionalState PCU_VRStatus (PCU_VR xVR);`
Behavior Description	This routine gets the *PCU* voltage regulator status.
Input Parameter	*xVR*: specifies the *PCU* voltage regulator. Refer to *PCU voltage regulators on page 19* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	The state of the specified voltage regulator. – *ENABLE*: The voltage regulator is enabled. – *DISABLE*: The voltage regulator is bypassed.
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to check the *PCU* voltage regulator status.

```
{
 FlagStatus MVR_Status;
 FlagStatus LPVR_Status;
...
 MVR_Status = PCU_VRStatus (PCU_MVR);
 LPVR_Status = PCU_VRStatus (PCU_LPR);
...
}
```

PCU_LVDStatus

Function Name	PCU_LVDStatus
Function Prototype	`FunctionalState PCU_LVDStatus (void);`
Behavior Description	This routine gets and returns the LVD status.
Input Parameter	None
Output Parameter	None
Return Value	The *LVD* status. – *ENABLE*: the *LVD* is enabled – *DISABLE*: .
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to check the *LVD* feature status.

```
{
...
 FunctionalState LVD_Status;
 LVD_Status = PCU_LVDStatus ();
...
}
```

PCU_LPModesConfig

Function Name	PCU_LPModesConfig
Function Prototype	`void PCU_LPModesConfig (FunctionalState PLL1_State, FunctionalState MVR_State,FunctionalState FLASH_State, FunctionalState LPWFI_State,LPWFI_Clock_Typedef LPWFI_Clock);`
Behavior Description	This routine configures the different STR71x low power mode options.
Input Parameter 1	*PLL1_State*: the state of PLL1 when CK_AF selected. – *ENABLE*: PLL1 is not disabled when CK_AF is selected – *DISABLE*: PLL1 is disabled automatically when CK_AF is selected as system clock
Input Parameter 2	*MVR_State*: the state of the Main Voltage Regulator when CK_AF is selected. – *ENABLE*: MVREG is enabled during LPWFI and STOP modes – *DISABLE*: MVREG is disabled during LPWFI and STOP modes
Input Parameter 3	*FLASH_State*: the state of the flash during LPWFI and STOP modes. – *ENABLE*: Flash Stand-by mode during LPWFI and STOP modes – *DISABLE*: FLASH in powerdown during LPWFI and STOP modes
Input Parameter 4	*LPWFI_State*: the state of low power mode during LPWFI. – *ENABLE*: Enable Low power mode during WFI mode – *DISABLE*: Disable Low power mode disabled during WFI mode
Input Parameter 5	*LPWFI_Clock*: the selected clock during LPWFI. – *LPWFI_CLK2_16*: CLK2/16 is selected during LPWFI – *LPWFI_CK_AF*: CK_AF is selected during LPWFI
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example disables the PLL1 automatically when CK_AF is selected is selected as source clock, puts the FLASH in PWD mode, disables the MVR during STOP and WFI mode, enables low power mode during WFI mode (LPWI) and selects CK_AF as source clock during LPWFI mode.

```
{
/* User code */
/* Set the MVR disabled and the FLASH in PWD mode during STOP
mode */
  PCU_LPModesConfig(DISABLE,DISABLE,DISABLE,ENABLE,LPWFI_CK_AF);
  /*    |    |    |    |   |_CK_AF is selected during LPWFI
     |    |    |    |_Enable Low power mode during WFI mode
     |    |    |_FLASH in powerdown during LPWFI and STOP modes
     |    |_MVREG is disabled during LPWFI and STOP modes
     |_PLL1 is disabled automatically when CK_AF is selected */
/* User code */
```

```
/* Go into STOP mode  */
    PCU_STOP();
/* User code */
/* Go into LPWFI mode */
    PCU_WFI();
/* User code */
  }
}
```

PCU_WFI

Function Name	PCU_WFI
Function Prototype	`void PCU_WFI (void);`
Behavior Description	This routine is used to enter WFI and LPWFI modes
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	*PCU_LPModesConfig* function should be called to configure the WFI mode options
Called Functions	None

Example 1:

This example configures WFI mode.

```
{
  /* Go into LPWFI mode */
  PCU_WFI();
}
```

Example 2:

This example configures LP_WFI mode with FLASH in PWD mode and MVR disabled, RCLK = CLK2_16

```
{
  /*Set the MVR disabled and the FLASH in PWD mode during LP_WFI
mode */

PCU_LPModesConfig(DISABLE,DISABLE,DISABLE,ENABLE,LPWFI_CLK2_16)
;
  /*   |    |    |    |   |_CLK2/16 selected during LPWFI
    |    |    |    |_Enable low power mode during WFI mode
    |    |    |_FLASH in powerdown during LPWFI and STOP modes
    |    |_MVREG is disabled during LPWFI and STOP modes
    |_PLL1 is disabled automatically when CK_AF is selected */

  /* Enter LPWFI mode */
  PCU_WFI();

}
```

Example 3:

This example configures LP_WFI mode with FLASH in PWD mode and MVR disabled, RCLK = CK_AF,

```
{
  /*Set the MVR disabled and the FLASH in PWD mode during LP_WFI
mode */
  PCU_LPModesConfig(DISABLE,DISABLE,DISABLE,ENABLE,LPWFI_CK_AF);
  /*   |    |    |    |   |_CK_AF is selected during LPWFI
    |    |    |    |_Enable Low power mode during WFI mode
    |    |    |_FLASH in powerdown during LPWFI and STOP modes
    |    |_MVREG is disabled during LPWFI and STOP modes
    |_PLL1 is disabled automatically when CK_AF is selected */

  /* Go into LPWFI mode */
  PCU_WFI();
}
```

PCU_STOP

Function Name	PCU_STOP
Function Prototype	`void PCU_WFI (void);`
Behavior Description	This routine is used to enter STOP mode.
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	PCU_LPModesConfig function should be called to configure the STOP mode options
Called Functions	None

Example:

This example configures STOP FLASH in PWD mode and MVR disabled.

```
{
  /*Set the MVR disabled and the FLASH in PWD mode during STOP
mode. */
  PCU_LPModesConfig(DISABLE,DISABLE,DISABLE,ENABLE,LPWFI_CK_AF);
  /*   |    |    |    |   |_CK_AF is selected during LPWFI
    |    |    |    |_Enable Low power mode during WFI mode
    |    |    |_FLASH in powerdown during LPWFI and STOP modes
    |    |_MVREG is disabled during LPWFI and STOP modes
    |_PLL1 is disabled automatically when CK_AF is selected */

  /*Go into STOP mode  */
  PCU_STOP()
}
```

PCU_STANDBY

Function Name	PCU_STANDBY
Function Prototype	`void PCU_STANDBY (void);`
Behavior Description	This routine is used to enter STANDBY mode
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This examples configures the RTC alarm then goes into STANDBY mode

```
{
  /* Configure RTC alarm after RTC_ALARM_DELAY s */
  RTC_AlarmConfig(RTC_CounterValue() + RTC_ALARM_DELAY);

  /* Go into Standby */
  PCU_STANDBY();
}
```

PCU_FlashBurstCmd

Function Name	PCU_FlashBurstCmd
Function Prototype	`PCU_FlashBurstCmd(FunctionalState NewState);`
Behavior Description	This routine is used to set the FLASH to LP/BURST mode
Input Parameter	*NewStatus*: specifies whether the FLASH BURST mode is enabled or disabled. – ENABLE: FLASH in BURST mode (default mode) – DISABLE: FLASH in LP mode, the maximum allowed execution frequency = 33 MHz
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example shows how to enable/disable FLASH Burst mode.

```
{

  /* Set the FLASH in LP mode */
  PCU_FlashBurstCmd(DISABLE);

  /* Set the FLASH in BURST mode */
  PCU_FlashBurstCmd(ENABLE);
}
```

PCU_32OSCCmd

Function Name	PCU_32OSCCmd
Function Prototype	`void PCU_32OSCCmd (FunctionalState NewState)`
Behavior Description	Enables or disables the 32 kHz oscillator
Input Parameter	*NewState*: specifies whether the 32 kHz oscillator is enabled or disabled. – *ENABLE*: enables the 32 kHz oscillator. – *DISABLE*: disables the 32 kHz oscillator.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to enable the 32 kHz oscillator.

```
{ ...

  /* Enable the 32 kHz oscillator */
  PCU_32OSCCmd(ENABLE);
...
}
```

3.2 Reset and clock control unit (RCCU)

The *RCCU* driver may be used for a variety of purposes, including internal clock configuration and clock source selection.

The first section describes the data structure members used in the *RCCU* firmware library. The second section presents the *RCCU* firmware library functions.

3.2.1 Data structures

RCCU register structure

The *RCCU* peripheral register structure *RCCU_TypeDef* is defined in the *71x_map.h* file as follows:

```
typedef volatile struct
{
  vu32 CCR;
  u32 EMPTY1;
  vu32 CFR;
  u32 EMPTY2[3];
  vu32 PLL1CR;
  vu32 PER;
  vu32 SMR;
} RCCU_TypeDef;
```

Table 10 presents the *RCCU* registers.

Table 10. RCCU registers

Register	Description
CCR	Clock Control Register
CFR	Clock Flag Register
PLL1CR	*PLL1* configuration Register
PER	Peripheral Clock Enable Register
SMR	System Mode Register

The *RCCU* peripheral is declared in the same file:

```
...
#define RCCU_BASE   0xA0000000
...
#ifndef DEBUG
...
#ifdef _RCCU
  #define RCCU                ((RCCU_TypeDef *)RCCU_BASE)
#endif /*RCCU*/
...
#else   /* DEBUG */
...
#ifdef _RCCU
    EXT RCCU_TypeDef          *RCCU;
#endif /*RCCU*/
...
#endif
```

When debug mode is used, *RCCU* pointer is initialized in *71x_lib.c* file:

```
 #ifdef _RCCU
#ifdef _RCCU
  RCCU = (RCCU_TypeDef *)RCCU_BASE;
#endif
```

In debug mode the following macro is defined in *71x_conf.h* file:

- *_RCCU* is defined to access the corresponding peripheral registers.

```
#define _RCCU
```

Clock divider parameters

The following enumeration defines the clock divider parameters. *Clock_Div* enumeration is defined in the file *71x_rccu.h*:

```
typedef enum
{RCCU_DEFAULT = 0x00,
  RCCU_RCLK_2 = 0x01,
  RCCU_RCLK_4 = 0x02,
  RCCU_RCLK_8 = 0x03
} RCCU_Clock_Div;
```

Table 11 lists the different values of the clock divider parameter.

Table 11. Clock divider parameters

Clock Divider	Description
RCCU_DEFAULT	The default divider (reset value) division by 1
RCCU_RCLK_2	Divide the *RCLK* by 2
RCCU_RCLK_4	Divide the *RCLK* by 4
RCCU_RCLK_8	Divide the *RCLK* by 8

RCLK clock source

The following enumeration defines the *RCLK* clock sources. *RCLK_Clocks* enumeration is defined in the file *71x_rccu.h*:

```
typedef enum
{
RCCU_PLL1_Output,
RCCU_CLOCK2_16,
RCCU_CLOCK2,
RCCU_CK_AF
} RCCU_RCLK_Clocks;
```

Table 12 describes the *RCLK* clock sources.

Table 12. RCLK clock sources

RCLK Clock Source	Description
RCCU_PLL1_Output	Select the *PLL1* output as *RCLK* clock source
RCCU_CLOCK2_16	Select the *RCLK2/16* as *RCLK* clock source
RCCU_CLOCK2	Select the *Clock2* as *RCLK* clock source
RCCU_CK_AF	Select the *RTC* as RCLK clock source

PLL1 multiplication factors

The following enumeration defines the *PLL1* multiplication factors. *RCCU_PLL1_Mul* enumeration is declared in the file *71x_rccu.h*:

```
typedef enum
{
  RCCU_PLL1_Mul_12 = 0x01,
  RCCU_PLL1_Mul_16 = 0x03,
  RCCU_PLL1_Mul_20 = 0x00,
  RCCU_PLL1_Mul_24 = 0x02
} RCCU_PLL1_Mul;
```

Table 13 lists the different values of the *PLL1* multiplication factor.

Table 13. PLL1 multiplication factors

PLL Multiplication factor	Description
RCCU_PLL1_Mul_12	Multiplication factor equal to 12
RCCU_PLL1_Mul_16	Multiplication factor equal to 16
RCCU_PLL1_Mul_20	Multiplication factor equal to 20
RCCU_PLL1_Mul_24	Multiplication factor equal to 24

PLL2 multiplication factors

The following enumeration defines the *PLL2* multiplication factors. *RCCU_PLL2_Mul* enumeration is declared in the file *71x_rccu.h*:

```
typedef enum
{
  RCCU_PLL2_Mul_12 = 0x01,
  RCCU_PLL2_Mul_16 = 0x03,
  RCCU_PLL2_Mul_20 = 0x00,
  RCCU_PLL2_Mul_28 = 0x02
} RCCU_PLL2_Mul;
```

Table 14 lists the different values of the *PLL2* multiplication factor.

Table 14. PLL2 multiplication factors

PLL Multiplication factor	Description
RCCU_PLL2_Mul_12	Multiplication factor equal to 12
RCCU_PLL2_Mul_16	Multiplication factor equal to 16
RCCU_PLL2_Mul_20	Multiplication factor equal to 20
RCCU_PLL2_Mul_28	Multiplication factor equal to 28

PLL division factors

The following enumeration defines the *PLL* division factors. *RCCU_PLL_Div* enumeration is declared in the file *71x_rccu.h*:

```
typedef enum
{RCCU_Div_1 = 0x00,
  RCCU_Div_2 = 0x01,
  RCCU_Div_3 = 0x02,
  RCCU_Div_4 = 0x03,
  RCCU_Div_5 = 0x04,
  RCCU_Div_6 = 0x05,
  RCCU_Div_7 = 0x06
} RCCU_PLL_Div;
```

Table 15 lists the different values of the *PLL* division factor.

Table 15. PLL division factors

PLL Division factor	Description
RCCU_Div_1	Division factor equal to 1
RCCU_Div_2	Division factor equal to 2
RCCU_Div_3	Division factor equal to 3
RCCU_Div_4	Division factor equal to 4
RCCU_Div_5	Division factor equal to 5
RCCU_Div_6	Division factor equal to 6
RCCU_Div_7	Division factor equal to 7

USB clock source

The following enumeration defines the *USB* clock sources. *USB_Clocks* enumeration is defined in the file *71x_rccu.h*:

```
typedef enum
{RCCU_PLL2_Output = 0x01,
  RCCU_USBCK = 0x00
} RCCU_USB_Clocks;
```

Table 16 describes the *USB* clock sources.

Table 16. USB clock sources

USB Clock Source	Description
RCCU_PLL2_Output	Select the *PLL2* output as *USB* clock source
RCCU_USBCK	Select the *USBCK* as *USB* clock source

RCCU internal clocks

The following enumeration defines the *RCCU* internal clocks. *RCCU_Clocks* enumeration is defined in the file *71x_rccu.h*:

```
typedef enum
{RCCU_CLK2,
  RCCU_RCLK,
  RCCU_MCLK,
  RCCU_PCLK2,
  RCCU_PCLK1
} RCCU_Clocks;
```

Table 17 describes the RCCU internal clocks.

Table 17. RCCU internal clocks

RCCU Clock	Description
RCCU_CLK2	The reference input clock to the programmable Phase Locked Loop frequency multiplier.
RCCU_RCLK	Clock Output from *RCCU*
RCCU_MCLK	Main system clock, to ARM & memory
RCCU_PCLK1	APB1 peripheral clock.
RCCU_PCLK2	APB2 peripheral clock.

RCCU interrupts

The following enumeration defines the *RCCU* interrupt source. *RCCU_Interrupts* enumeration is defined in the file *71x_rccu.h*:

```
typedef enum
{
 RCCU_PLL1_LOCK_IT,
 RCCU_CKAF_IT,
 RCCU_CK2_16_IT,
 RCCU_STOP_IT
} RCCU_Interrupts;
```

Table 18 describes the *RCCU* interrupts.

Table 18. RCCU interrupts

RCCU Interrupt	Description
RCCU_PLL1_LOCK_IT	*PLL1* lock interrupt
RCCU_CKAF_IT	Clock alternate function switching interrupt
RCCU_CK2_16_IT	Clock2/16 switching interrupt
RCCU_STOP_IT	Stop interrupt

RCCU flags

The following enumeration defines the *RCCU* flags. *RCCU_Flags* enumeration is defined in the file *71x_rccu.h*:

```
typedef enum
            {
                RCCU_PLL1_LOCK = 0x0002,
                RCCU_CKAF_ST = 0x0004,
                RCCU_PLL1_LOCK_I = 0x0800,
                RCCU_CKAF_I = 0x1000,
                RCCU_CK2_16_I = 0x2000,
                RCCU_STOP_I = 0x4000
              } RCCU_Flags;
```

Table 19 describes the *RCCU* flags.

Table 19. RCCU flags

RCCU flag	Description
RCCU_PLL1_LOCK	*PLL1* lock interrupt pending flag
RCCU_CKAF_ST	*CK_AF* Status
RCCU_PLL1_LOCK_I	*PLL1* Lock Interrupt pending bit
RCCU_CKAF_I	Clock alternate function switching interrupt pending flag
RCCU_CK2_16_I	Clock2/16 switching interrupt pending flag
RCCU_STOP_I	Stop Interrupt pending bit

Reset sources

The following enumeration defines the *RCCU* reset sources. *RCCU_ResetSources* enumeration is defined in the file *71x_rccu.h*:

```
typedef enum {
               RCCU_ExternalReset = 0x00000000,
               RCCU_SoftwareReset = 0x00000020,
               RCCU_WDGReset = 0x00000040,
               RCCU_RTCAlarmReset = 0x00000080,
               RCCU_LVDReset = 0x00000200,
               RCCU_WKPReset = 0x00000400
              }RCCU_ResetSources;
```

Table 20 describes the *RCCU* reset sources.

Table 20. RCCU reset sources

RCCU reset sources	Description
RCCU_ExternalReset	Reset caused by external pin
RCCU_SoftwareReset	Reset caused by software
RCCU_WDGReset	Reset caused by Watchdog
RCCU_RTCAlarmReset	Reset caused by *RTC* to wake-up the system from StandBy mode
RCCU_LVDReset	Reset caused by *LVD*
RCCU_WKPReset	Reset caused by wake-up pin to wake-up the system from StandBy mode

PLL1 free running modes

The following enumeration defines the PLL1 free dunning modes. *RCCU_PLL1FreeRunningModes* enumeration is declared in the file *71x_rccu.h*:

```
typedef enum {
               RCCU_PLL1FreeRunning125,
               RCCU_PLL1FreeRunning250,
               RCCU_PLL1FreeRunning500
              }RCCU_PLL1FreeRunningModes;
```

Table 21 describes the PLL1 free running modes.

Table 21. PLL1 free running modes

PLL1 free running modes	Description
RCCU_PLL1FreeRunning125	PLL1 provides 125 kHz
RCCU_PLL1FreeRunning250	PLL1 provides 250 kHz
RCCU_PLL1FreeRunning500	PLL1 provides 500 kHz

3.2.2 Firmware library functions

The following table enumerates the different functions of the *RCCU* library.

Function Name	Description
RCCU_Div2Config	Enables/Disables the programmable clock division by two
RCCU_Div2Status	Checks if the programmable clock division by 2 is enabled or not
RCCU_MCLKConfig	Configures the *MCLK* clock divider coefficient
RCCU_PCLK1Config	Configures the *PCLK1* clock divider coefficient
RCCU_PCLK2Config	Configures the *PCLK2* clock divider coefficient
RCCU_PLL1Config	Configures the *PLL1* multiplication and divider parameters
RCCU_PLL2Config	Configures the *PLL2* multiplication and divider parameters
RCCU_RCLKSourceConfig	Configures the *RCLK* clock source
RCCU_RCLKClockSource	Reads and returns the *RCLK* clock source
RCCU_USBCLKConfig	Configures the *USB* clock source
RCCU_USBClockSource	Reads and returns the *USB* clock source
RCCU_FrequencyValue	Computes any internal *RCCU* clock frequency
RCCU_ITConfig	Configures the *RCCU* interrupts
RCCU_FlagStatus	Checks the *RCCU* interrupt status
RCCU_FlagClear	Clears an *RCCU* flag
RCCU_ResetSource	Returns the source of the system reset
RCCU_PLL1FreeRunningModeConfig	This routine is used to configures the PLL1 in free running mode
RCCU_PLL1Disable	This routine is used to switch off the PLL1
RCCU_PLL2Disable	This routine is used to switch off the PLL2
RCCU_GenerateSWReset	This routine generates software reset.

RCCU_Div2Config

Function Name	RCCU_Div2Config
Function Prototype	`void RCCU_Div2Config(FunctionalState NewState);`
Behavior Description	This routine is used to enable or disable the programmable clock division of the *CLOCK1* input clock signal by 2. It sets or clears the *Div2* flag in the *CLK_FLAG* register
Input Parameter	*NewState*: specifies whether the programmable divider can divide the *CLOCK1* input clock signal by two or not – *ENABLE*: enables the clock division by two of of CLK signal – *DISABLE*: disables the clock division by two of of CLK signal
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to enable the clock division by two:

```
RCCU_Div2Config (ENABLE);
/* Sets the Div2 flag in the CLK_FLAG register. */
```

RCCU_Div2Status

Function Name	RCCU_Div2Status
Function Prototype	`FlagStatus RCCU_Div2Status (void);`
Behavior Description	This routine gets the current status of the programmable clock division by two. It checks the status of the *Div2* flag in the *CLK_FLAG* register
Input Parameter	None
Output Parameter	None
Return Value	The Div2 Flag status. – *SET*: The division by 2 is enabled – *RESET*: The division by 2 is disabled
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to enable the programmable clock divider if it is not enabled.

```
FlagStatus Current_Div2Flag;
if (Current_Div2Flag == RESET)
{
 RCCU_Div2Config (ENABLE);
 /*.....................User Code.......................*/
}
```

RCCU_MCLKConfig

Function Name	RCCU_MCLKConfig
Function Prototype	`void RCCU_MCLKConfig(Clock_Div New_Clock);`
Behavior Description	This routine is used to configure the *MCLK* clock divider.
Input Parameter	*New_Clock*: Specifies the *MCLK* clock divider value. Refer to *Clock divider parameters on page 30* for more details on the allowed values of this parameter
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Note: The MCLK frequency must be greater or equal to the frequency of APB1 and APB2 bridges.

Example:

This example illustrates how to set the *MCLK* clock to *RCLK* / 1.

```
{
...
 RCCU_MCLKConfig (RCCU_DEFAULT);
...
}
```

RCCU_PCLK1Config

Function Name	RCCU_PCLK1Config
Function Prototype	`void RCCU_PCLK1Config(Clock_Div New_Clock);`
Behavior Description	This routine is used to select the division factor for RCLK to obtain the PCLK1 clock for the APB1 fast peripherals (PCLK1).
Input Parameter	*New_Clock*: Specifies the *PCLK1* clock divider value. Refer to *Clock divider parameters on page 30* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to set the *PCLK1* clock to *RCLK* / 8.

```
{
 ..
 RCCU_PCLK1Config(RCCU_RCLK_8);
...
}
```

RCCU_PCLK2Config

Function Name	RCCU_PCLK2Config
Function Prototype	`void RCCU_PCLK2Config(Clock_Div New_Clock);`
Behavior Description	This routine is used to select the division factor for RCLK to obtain the PCLK2 clock for the APB2 peripherals (PCLK2).
Input Parameter	*New_Clock*: specifies the *PCLK2* clock divider value. Refer to *Clock divider parameters on page 30* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to set the *PCLK2* clock to *RCLK* / 2.

```
{
...
 RCCU_PCLK2Config (RCCU_RCLK_2);
...
}
```

RCCU_PLL1Config

Function Name	RCCU_PLL1Config
Function Prototype	`void RCCU_PLL1Config (RCCU_PLL1_Mul New_Mul, RCCU_PLL_Div New_Div );`
Behavior Description	This routine configures the PLL1 division and multiplication factors.
Input Parameter 1	*New_Mul*: the *PLL1* clock multiplication factor. Refer to *PLL1 multiplication factors on page 31* for more details on the allowed values of this parameter.
Input Parameter 2	*New_Div*: the *PLL1* clock division factor. Refer to *PLL division factors on page 32* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to set the *PLL1* multiplication factor to 20 and the divider factor to 5.

```
{
...
 RCCU_PLL1Config (RCCU_PLL1_Mul_20, RCCU_Div_5);
...
}
```

RCCU_PLL2Config

Function Name	RCCU_PLL2Config
Function Prototype	`void RCCU_PLL2Config (RCCU_PLL2_Mul New_Mul, RCCU_PLL_Div New_Div, u32 HCLK_Clock);`
Behavior Description	Configures the PLL2 division and multiplication factors.
Input Parameter 1	*New_Mul*: the *PLL2* clock multiplication factor. Refer to *PLL2 multiplication factors on page 32* for more details on the allowed values of this parameter.
Input Parameter 2	*New_Div*: the *PLL2* clock division factor. Refer to *PLL division factors on page 32* for more details on the allowed values of this parameter.
Input Parameter 3	*HCLK_Clock*: the clock value present on HCLK pin (in Hz).
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to set the *PLL2* multiplication factor to 28 and the divider factor to 7.

```
{
...
 RCCU_PLL2Config (RCCU_PLL2_Mul_28, RCCU_Div_7,4000000);
...
}
```

RCCU_RCLKSourceConfig

Function Name	RCCU_RCLKSourceConfig
Function Prototype	`void RCCU_RCLKSourceConfig(RCLK_Clocks New_Clock);`
Behavior Description	This routine selects the clock source for the *RCLK*.
Input Parameter	*New_Clock*: the RCLK clock source. Refer to *RCLK clock source on page 31* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to set the *PLL1* multiplication factor to 20 and the divider factor to 4 then select *PLL1* output as clock source of *RCLK* clock.

```
{
...
 RCCU_PLL1Config (RCCU_Mul_20, RCCU_Div_4);
/* Wait PLL to lock */
  while(RCCU_FlagStatus (RCCU_PLL1_LOCK) == RESET);
 RCCU_RCLKSourceConfig (RCCU_PLL1_Output);
...
}
```

RCCU_RCLKClockSource

Function Name	RCCU_RCLKClockSource
Function Prototype	`RCLK_Clocks RCCU_RCLKClockSource (void);`
Behavior Description	This routine gets and returns the current clock source of the *RCLK*.
Input Parameter	None
Output Parameter	None
Return Value	The current *RCLK* clock source. Refer to *RCLK clock source on page 31* for more details on the allowed values of this parameter.
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to get the *RCLK* clock source.

```
{
...
 RCLK_Clocks RCLK_CLOCK_SOURCE;
 RCLK_CLOCK_SOURCE = RCCU_RCLKClockSource ();
...
}
```

RCCU_USBCLKConfig

Function Name	RCCU_USBCLKConfig
Function Prototype	`void RCCU_USBCLKConfig (USB_Clocks New_Clock);`
Behavior Description	This routine is used to select the clock source of the *USB* peripheral.
Input Parameter	*New_Clock*: the USB clock source. Refer to *USB clock source on page 33* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to configure the *USB* peripheral source clock as *PLL2* output.

```
{
...
 RCCU_USBCLKConfig (RCCU_PLL2_Output);
...
}
```

RCCU_USBClockSource

Function Name	RCCU_USBClockSource
Function Prototype	`USB_Clocks RCCU_USBClockSource (void);`
Behavior Description	This routine gets the clock source of the *USB* peripheral.
Input Parameter	None
Output Parameter	None
Return Value	The *USB* clock source. Refer to *USB clock source on page 33* for more details on the allowed values of this parameter.
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to get the *USB* clock source:

```
{
RCCU_USB_Clocks Current_USBClock;
...
 Current_USBClock = RCCU_USBClockSource ();
...
}
```

RCCU_FrequencyValue

Function Name	RCCU_FrequencyValue
Function Prototype	`u32 RCCU_FrequencyValue(RCCU_Clocks Internal_Clk);`
Behavior Description	This routine computes any internal *RCCU* clock frequency value passed in parameters.
Input Parameter	*Internal_Clk*: the *RCCU* internal clock to compute the frequency. Refer to *RCCU internal clocks on page 33* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	The frequency value of the specified clock in Hz of the internal clock passed in parameter.
Required preconditions	None
Called Functions	None

Example:

This example illustrates how get the *MCLK* clock frequency value.

```
{
 u32 MCLK_Freq;
...
 MCLK_Freq = RCCU_FrequencyValue (RCCU_MCLK);
...
}
```

RCCU_ITConfig

Function Name	RCCU_ITConfig
Function Prototype	`void RCCU_ITConfig (RCCU_Interrupts RCCU_IT, FunctionalState NewState);`
Behavior Description	This routine configures the specified *RCCU* interrupts.
Input Parameter 1	*RCCU_IT*: specifies the *RCCU* interrupt to configure. Refer to *RCCU interrupts on page 34* for more details on the allowed values of this parameter.
Input Parameter 2	*NewState*: Indicates the new status of the *RCCU* interrupt. – *ENABLE*: to enable the specified interrupt – *DISABLE*: to disable the specified interrupt
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to configure the *PLL1* lock interrupt.

```
{
...
 RCCU_ITConfig (RCCU_PLL1_LOCK_IT, ENABLE);
...
}
```

RCCU_FlagStatus

Function Name	RCCU_FlagStatus
Function Prototype	`FlagStatus RCCU_FlagStatus(RCCU_Flags RCCU_flag);`
Behavior Description	Checks whether the specified interrupt is enabled or disabled.
Input Parameter	*RCCU_flag*: the flag to see its status. Refer to *RCCU flags on page 34* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	The specified interrupt status. – *SET*: The specified flag is set. – *RESET*: The specified flag is reset
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to check if the *PLL1* is locked.

```
{
...
   while (RCCU_FlagStatus (RCCU_PLL1_LOCK_IT) == RESET);
...
}
```

RCCU_FlagClear

Function Name	RCCU_FlagClear
Function Prototype	`void RCCU_FlagClear (RCCU_Flags RCCU_flag);`
Behavior Description	This routine is used to clear the specified interrupt flag in the RCCU registers passed in parameter.
Input Parameter	*RCCU_flag*: Specifies the flag to clear. Refer to *RCCU flags on page 34* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to clear *PLL1* lock pending interrupt flag.

```
{
...
 RCCU_FlagClear (RCCU_PLL1_LOCK_I);
...
}
```

RCCU_ResetSource

Function Name	RCCU_ResetSource
Function Prototype	`RCCU_ResetSources RCCU_ResetSource (void);`
Behavior Description	This routine is used to return the system reset source.
Input Parameter	None
Output Parameter	None
Return Value	The reset source
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to define the system reset source.

```
{
RCCU_ResetSources ResetSource;
ResetSource=RCCU_ResetSource();
  switch (ResetSource)
  {
    case RCCU_RTCAlarmReset: GPIO_BitWrite(GPIO0,0,1);break;
    case RCCU_WKPReset: GPIO_BitWrite(GPIO0,1,1);break;
    default                                 :
GPIO_BitWrite(GPIO0,3,1);break;
  }
}
```

RCCU_PLL1FreeRunningModeConfig

Function Name	RCCU_PLL1FreeRunningModeConfig
Function Prototype	`RCCU_PLL1FreeRunningModeConfig(RCCU_PLL1FreeRunningModes NewPll1FreeRunningMode);`
Behavior Description	This routine is used to configure the PLL1 in free running mode
Input Parameter	RCCU_PLL1FreeRunningModes: PLL1 in free running mode. Refer to *PLL1 free running modes on page 35*
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example shows how to clock the system with the PLL1 configured in free running mode.

```
{
  /*Configure the PLL in free running mode at 125kHz */
  RCCU_PLL1FreeRunningModeConfig(RCCU_PLL1FreeRunning125);

  /* Set the RCLK to the PLL1 output */
  RCCU_RCLKSourceConfig(RCCU_PLL1_Output);
}
```

RCCU_PLL1Disable

Function Name	RCCU_PLL1Disable
Function Prototype	`void RCCU_PLL1Disable (void);`
Behavior Description	This routine is used to switch off the PLL1
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example shows how to switch off the PLL1.

```
{
  /* switch off the PLL1 */
  RCCU_PLL1Disable ();
}
```

RCCU_PLL2Disable

Function Name	RCCU_PLL2Disable
Function Prototype	`void RCCU_PLL2Disable (void);`
Behavior Description	This routine is used to switch off the PLL2
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example shows how to switch off the PLL2.

```
{
  /* switch off the PLL2 */
  RCCU_PLL2Disable ();
}
```

RCCU_GenerateSWReset

Function Name	RCCU_GenerateSWReset
Function Prototype	`void RCCU_GenerateSWReset (void);`
Behavior Description	This routine is used to generate a software reset.
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example shows how to generate the software reset.

```
{
  /* Generate Software Reset */
RCCU_GenerateSWReset ();
}
```

3.3 Advanced peripheral bus bridges (APB)

The *APB* driver may be used for a variety of purposes, including *APB* bridges configuration and error status reporting.

The first section describes the data structure members used in the *APB* firmware library. The second section presents the *APB* firmware library functions.

3.3.1 Data structures

APB register structure

The *APB* peripheral register structure *APB_TypeDef* is defined in the *71x_map.h* file as follows:

```
typedef struct
{
  vu32 CKDIS;
  vu32 SWRES;
} APB_TypeDef;
```

Table 22 presents the *APB* registers.

Table 22. APB registers

Register	Description
CKDIS	*APB* Clock Disable Register
SWRES	*APB* Software Reset Register

The *APB* bridges are declared in the same file:

```
...
#define APB1_BASE   0xC0000000
#define APB2_BASE   0xE0000000
....
#ifndef DEBUG
...
#ifdef _APB1
  #define APB1                ((APB_TypeDef *)(APB1_BASE+0x10))
#endif /*APB1*/

#ifdef _APB2
  #define APB2                ((APB_TypeDef *)(APB2_BASE+0x10))
#endif /*APB2*/
...
#else  /* DEBUG */
...
#ifdef _APB1
    EXT APB_TypeDef           *APB1;
#endif /*APB1*/

#ifdef _APB2
    EXT APB_TypeDef           *APB2;
#endif /*APB2*/
...
#endif
```

When debug mode is used, *APB* pointer is initialized in *71x_lib.c* file:

```
#ifdef _APB1
#ifdef _APB1
  APB1 = (APB_TypeDef *)    (APB1_BASE + 0x10);
#endif
#endif /* _APB1 */

#ifdef _APB2
  APB2 = (APB_TypeDef *)    (APB2_BASE + 0x10);
#endif /* _APB2 */
```

In debug mode the following macros are defined in *71x_conf.h* file:

- *_APB* is defined to include the *APB* library
- *_APB1* and *_APB2* are defined to access the corresponding peripheral registers.

```
#define _APB
#define _APB1
#define _APB2
```

Bridge peripheral codes

Table 23 enumerates the various peripherals and their defined codes depending on which bridge they belong.

Table 23. Bridge peripheral codes

Peripheral	Bridge	Code definition
I2C0_Periph	*APB1* Bridge	0x0001
I2C1_Periph		0x0002
UART0_Periph		0x0008
UART1_Periph		0x0010
UART2_Periph		0x0020
UART3_Periph		0x0040
USB_Periph		0x0080
CAN_Periph		0x0100
BSPI0_Periph		0x0200
BSPI1_Periph		0x0400
HDLC_Periph		0x2000
APB1_ALL_Periph		0x27FB
XTI_Periph	*APB2* Bridge	0x0001
GPIO0_Periph		0x0004
GPIO1_Periph		0x0008
GPIO2_Periph		0x0010
ADC12_Periph		0x0040
CKOUT_Periph		0x0080
TIM0_Periph		0x0400
TIM1_Periph		0x0200
TIM2_Periph		0x0400
TIM3_Periph		0x0800
RTC_Periph		0x1000
EIC_Periph		0x8000
APB2_ALL_Periph		0x5FDD

Each peripheral code is defined in the *71x_apb.h* file. The example below illustrates the definition of *I2C0* peripheral code:

```
#define I2C0_Periph      0x0001
```

3.3.2 Common parameter values

APBx values

Table 24 shows the allowed values of the APBx variable.

Table 24. APBx values

APBx	Description
APB1	Selects *APB1* bridge
APB2	Selects *APB2* bridge

3.3.3 Firmware library functions

Table 25 enumerates the different functions of the *APB* library.

Table 25. APB library functions

Function Name	Description
APB_ClockConfig	Enables/Disables the peripheral clock gating on the specified *APB* bridge.
APB_SwResetConfig	Enables/Disables the software reset for peripherals on the specified *APB* bridge.

APB_ClockConfig

Function Name	APB_ClockConfig
Function Prototype	`void APB_ClockConfig (APB_TypeDef *APBx, FunctionalState NewState, u16 Periph);`
Behavior Description	Enables/Disables the peripheral clock gating on the specified *APB* bridge.
Input Parameter 1	APBx: selects the APB bridge (APB1 or APB2)
Input Parameter 2	*NewStatus*: specifies if the peripheral clock is running or stopped. – *ENABLE*: The peripheral clock is running – *DISABLE*: The peripheral clock is stopped.
Input Parameter 3	*Periph*: specifies the *APB* bridge peripheral: Refer to *Bridge peripheral codes on page 49* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Note: 1 One or more peripheral clocks can be enabled on the same APB bridge with a single APB_ClockConfig function call. One or more peripheral clocks can be disabled with another APB_ClockConfig function call.

2 It is not possible to simultaneously enable and disable several peripheral clocks in a single APB_ClockConfig function call.

Example:

This example enables clock gating for *I2C0* and *UART1* peripherals on the *APB1* bridge and disables the clock for *GPIO2*, *ADC12* peripherals on the *APB2* bridge.

```
{
 /* Enables the clock signal to the I2C0 peripheral. */
 APB_ClockConfig (APB1, ENABLE, I2C0_Periph);

 /* Enables the clock signal to the UART1 peripheral.*/
 APB_ClockConfig (APB1, ENABLE, UART1_Periph);

 /* Disables the clock signal to the GPIO2 peripheral. */
 APB_ClockConfig (APB2, DISABLE, GPIO2_Periph);

 /* Disables the clock signal to the ADC12 peripheral. */
 APB_ClockConfig (APB2, DISABLE, ADC12_Periph);
}
```

The *APB_ClockConfig* parameter 3 can accept several peripherals using the logical operator OR.

```
{
 /* Enables the clock signal to the I2C0 & UART1 peripherals */
 APB_ClockConfig (APB1, ENABLE, I2C0_Periph | UART1_Periph);

 /* Disables the clock signal to the GPIO2 & ADC12 peripherals */
 APB_ClockConfig (APB2, DISABLE, GPIO2_Periph | ADC12_Periph);
}
```

APB_SwResetConfig

Function Name	APB_SwResetConfig
Function Prototype	`void APB_SwResetConfig (APB_TypeDef *APBx, FunctionalState New_Status, u16 Periph);`
Behavior Description	This function enables/disables the software reset for the specified peripheral on the specified *APB* Bridge. It updates the bits[14:0] of the *SWRES* register with the value of the input parameter.
Input Parameter 1	APBx: selects the APB bridge (APB1 or APB2).
Input Parameter 2	*New_Status*: the peripheral software reset new status to be set. – *ENABLE*: The peripheral is kept under reset – *DISABLE*: The peripheral is reset by the system-wide reset
Input Parameter 3	*Periph*: specifies the *APB* bridge peripheral: Refer to *Bridge peripheral codes on page 49* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Note: 1 One or more peripheral software resets can be enabled on the same APB bridge with a single APB_SwResetConfig function call. One or more peripheral software resets can be disabled with another APB_SwResetConfig function call.

2 It is not possible to simultaneously enable and disable several peripheral software resets in a single APB_SwResetConfig function call.

Example:

This example illustrates how to configure the *BSPI0* and the *BSPI1* peripherals to be kept always under reset:

```
{
 APB_SwResetConfig (APB1, ENABLE, BSPI0_Periph | BSPI1_Periph);
}
```

3.4 Enhanced interrupt controller (EIC)

The driver may be used for several purposes, such as enabling and disabling interrupts (*IRQ*) and fast interrupts (*FIQ*), enabling and disabling individual *IRQ* channels, changing *IRQ* channel priorities, saving and restoring context and installing *IRQ* handlers.

The first and the second sections describe the data structure and the common parameter values. The second one presents the *EIC* firmware library functions.

3.4.1 Data structures

EIC register structure

The *EIC* peripheral register structure *EIC_TypeDef* is defined in the file *71x_map.h* as follows:

```
typedef volatile struct
{
  vu32 ICR;
  vu32 CICR;
  vu32 CIPR;
  u32 EMPTY1[3];
  vu32 IVR;
  vu32 FIR;
  vu32 IER;
  u32 EMPTY2[7];
  vu32 IPR;
  u32 EMPTY3[7];
  u32 SIR[32];
} EIC_TypeDef;
```

Table 26 presents the *EIC* peripheral registers.

Table 26. EIC peripheral registers

Register	Description
ICR	Interrupt Control Register
CICR	Current Interrupt Channel Register
CIPR	Current Interrupt Priority Register
IVR	Interrupt Vector Register
FIR	Fast Interrupt Register
IER	Interrupt Enable Register
IPR	Interrupt Pending Register
SIR	Source Interrupt Registers

EIC peripheral is declared in the *71x_map.h* file as follows:

```
...
/* EIC Base Address Definition */
#define EIC_BASE    0xFFFFF800
...
#ifndef DEBUG
...
#ifdef _EIC
  #define EIC                ((EIC_TypeDef *)EIC_BASE)
#endif /*EIC*/
...
#else  /* DEBUG */
...
#ifdef _EIC
    EXT EIC_TypeDef          *EIC;
#endif /*EIC*/)
...
#endif
```

When debug mode is used, *EIC* pointer is initialized in *71x_lib.c* file as follows:

```
#ifdef _EIC
  EIC = (EIC_TypeDef *)EIC_BASE;
#endif
```

In debug mode *_EIC* variable must be defined in *71x_conf.h* file to include the *EIC* library:

```
#define _EIC
```

IRQ channel enumeration

The following enumeration defines the different values of the *IRQ* channels. *IRQChannel_TypeDef* enumeration id defined id *eic.h* file:

```
typedef enum
{
  T0TIMI_IRQChannel     = 0,
  FLASH_IRQChannel      = 1,
  RCCU_IRQChannel       = 2,
  RTC_IRQChannel        = 3,
  WDG_IRQChannel        = 4,
  XTI_IRQChannel        = 5,
  USBHP_IRQChannel      = 6,
  I2C0ITERR_IRQChannel  = 7,
  I2C1ITERR_IRQChannel  = 8,
  UART0_IRQChannel      = 9,
  UART1_IRQChannel      = 10,
  UART2_IRQChannel      = 11,
  UART3_IRQChannel      = 12,
  SPI0_IRQChannel       = 13,
  SPI1_IRQChannel       = 14,
  I2C0_IRQChannel       = 15,
  I2C1_IRQChannel       = 16,
  CAN_IRQChannel        = 17,
  ADC_IRQChannel        = 18,
  T1TIMI_IRQChannel     = 19,
  T2TIMI_IRQChannel     = 20,
  T3TIMI_IRQChannel     = 21,
  HDLC_IRQChannel       = 25,
  USBLP_IRQChannel      = 26,
  T0TOI_IRQChannel      = 29,
  T0OC1_IRQChannel      = 30,
  T0OC2_IRQChannel      = 31
}IRQChannel_TypeDef;
```

Table 27 describes the different values of IRQChannel variable.

Table 27. IRQChannel values

IRQChannel	Peripheral Interrupt	Value
T0TIMI_IRQChannel	Timer 0 global interrupt	0
FLASH_IRQChannel	Embedded Flash global interrupt	1
RCCU_IRQChannel	RCCU global interrupt	2
RTC_IRQChannel	Real Time Clock global interrupts	3
WDG_IRQChannel	Watchdog timer interrupts	4
XTI_IRQChannel	WIU Wake-up event interrupt	5
USBHP_IRQChannel	USB high priority event interrupt	6
I2C0ITERR_IRQChannel	I^2C 0 error interrupt	7
I2C1ITERR_IRQChannel	I^2C 1 error interrupt	8
UART0_IRQChannel	UART 0 global interrupt	9
UART1_IRQChannel	UART 1 global interrupt	10
UART2_IRQChannel	UART 2 global interrupt	11
UART3_IRQChannel	UART 3 global interrupt	12
SPI0_IRQChannel	BSPI 0 global interrupt	13
SPI1_IRQChannel	BSPI 1 global interrupt	14
I2C0_IRQChannel	I^2C 0 global interrupt	15
I2C1_IRQChannel	I^2C 1 global interrupt	16
CAN_IRQChannel	CAN module global interrupt	17
ADC_IRQChannel	ADC sample ready interrupt	18
T1TIMI_IRQChannel	Timer 1 global interrupt	19
T2TIMI_IRQChannel	Timer 2 global interrupt	20
T3TIMI_IRQChannel	Timer 3 global interrupt	21
HDLC_IRQChannel	HDLC global interrupt	25
USBLP_IRQChannel	USB low priority event interrupt	26
T0TOI_IRQChannel	Timer 0 overflow interrupt	29
T0OC1_IRQChannel	Timer 0 output compare 1 interrupt	30
T0OC2_IRQChannel	Timer 0 output compare 2 interrupt	31

FIQ channel enumeration

The following enumeration defines the different values of the *FIQ* channel. *FIQChannel_TypeDef* enumeration is defined in the file *eic.h*:

```
typedef enum
{
  T0TIMI_FIQChannel     = 0x00000001,
  WDG_FIQChannel        = 0x00000002,
  WDGT0TIMI_FIQChannels = 0x00000003
} FIQChannel_TypeDef;
```

Table 28 describes the different values of FIQChannel.

Table 28. FIQChannel values

FIQChannel	Interrupt Source	Value
T0TIMI_FIQChannel	Timer 0 global interrupt	1
WDG_FIQChannel	Watchdog timer interrupt	2
WDGT0TIMI_FIQChannel	Both timer 0 global interrupt and watchdog interrupt. The two FIQs take place at the same time.	3

3.4.2 Firmware library functions

The table below enumerates the different functions of the *EIC* library.

Function Name	Function Description
EIC_Init	Initializes the Enhanced Interrupt Controller
EIC_IRQConfig	Enables or Disables IRQ interrupts in the EIC
EIC_FIQConfig	Enables or Disables FIQ interrupts in the EIC
EIC_IRQChannelConfig	Enables or Disables the selected IRQ channel interrupts
EIC_FIQChannelConfig	Enables or Disables the selected FIQ channel interrupts
EIC_IRQChannelPriorityConfig	Sets the IRQ channel priority level
EIC_CurrentPriorityLevelValue	Returns the current priority level
EIC_CurrentPriorityLevelConfig	Changes the current priority level
EIC_CurrentIRQChannelValue	Returns the current served IRQ channel number
EIC_CurrentFIQChannelValue	Returns the FIQ channel number causing the FIQ interrupt
EIC_FIQPendingBitClear	Clears FIQ Pending bit according to the input passed parameter

EIC_Init

Function Name	EIC_Init
Function Prototype	`void EIC_Init(void);`
Behavior Description	Initializes the Interrupt Controller as following: – *FIQ* and *IRQ* are disabled, – All channel interrupts are disabled, – All pending bits are cleared. – The current priority level set to zero, – *IVR* register initialized with the upper half of the load *PC* instruction op-code, – All *SIR* registers are initialized with the offset to the corresponding *IRQ* routine vector.
Input Parameter	None
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None

Note: The EIC is initialized in the 71x_init.s before entering the C code, so you don't need to initialize the EIC after a system reset. This function is required if a software reset is performed.

Example:

This example shows how to initialize the interrupt controller.

```
{
...
 /* Initialize the interrupt controller */
 EIC_Init();
...
}
```

EIC_IRQConfig

Function Name	EIC_IRQConfig
Function Prototype	`void EIC_IRQConfig(FunctionalState NewState);`
Behavior Description	Enables or Disables IRQ interrupts.
Input Parameter	*NewState*: specifies whether the *IRQ* is enabled or disabled. – *ENABLE*: enables the *IRQ* interrupt – *DISABLE*: disables the *IRQ* interrupt.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None
See also	*EIC_FIQConfig on page 58*

Example:

This example shows how to enable the *IRQ* interrupts.

```
{
...
 /*Enable IRQ interrupts */
 EIC_IRQConfig(ENABLE);
...
}
```

EIC_FIQConfig

Function Name	EIC_FIQConfig
Function Prototype	`void EIC_FIQConfig(FunctionalState NewState);`
Behavior Description	Sets or clears the *FIQ_EN* bit located in *EIC.CIR* register.
Input Parameter	*NewState*: the *FIQ* interrupt new status to be set. – *ENABLE*: enables the *FIQ* interrupt – *DISABLE*: disables the *FIQ* interrupt.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None
See also	*EIC_IRQConfig on page 58*

Example:

This example shows how to enable the *FIQ* interrupts.

```
{
 /*Enable FIQ interrupts */
 EIC_FIQConfig(ENABLE);
...
}
```

EIC_IRQChannelConfig

Function Name	EIC_IRQChannelConfig
Function Prototype	`void EIC_IRQChannelConfig(IRQChannel_TypeDef IRQChannel, FunctionalState NewState);`
Behavior Description	Configures the specified IRQ Channel.
Input Parameter 1	*IRQChannel*: the channel to be configured. Refer to *IRQ channel enumeration on page 54* for details on allowed values of *IRQChannel* parameter.
Input Parameter 2	*NewState*: specifies whether the *IRQ* channel interrupt will be enabled or disabled. – *ENABLE*: enables the channel interrupt – *DISABLE*: disables the channel interrupt
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None
See also	*EIC_IRQConfig on page 58*, *EIC_IRQChannelPriorityConfig on page 61*

Example:

This example shows how to enable the Timer 0 global interrupts and disable the *UART0* interrupts.

```
{
...
 /* Enable Timer 0 global interrupts */
 EIC_IRQChannelConfig(T0TIMI_IRQChannel, ENABLE);
...
 /* Disable UART 0 global interrupts */
 EIC_IRQChannelConfig(UART0_IRQChannel, DISABLE);
...
}
```

EIC_FIQChannelConfig

Function Name	EIC_FIQChannelConfig
Function Prototype	`void EIC_FIQChannelConfig(FIQChannel_TypeDef FIQChannel, FunctionalState NewState);`
Behavior Description	Sets or clears the corresponding channel bit located in *EIC.FIR* register.
Input Parameter 1	*FIQChannel*: the FIQ channel to be configured. Refer to *FIQ channel enumeration on page 55* for details on allowed values of *FIQChannel* parameter.
Input Parameter 2	NewState: specifies whether the FIQ channel interrupt will be enabled or disabled. – *ENABLE*: enables the *FIQ* channel interrupt – *DISABLE*: disables the *FIQ* channel interrupt
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None
See also	*EIC_FIQConfig on page 58*

Example:

This example how to disable the *WDG FIQ* interrupts and enable Timer 0 *FIQ* interrupts.

```
{
...
 /* Disable WDG FIQ interrupts */
 EIC_FIQChannelConfig(WDG_FIQChannel, DISABLE);
...
 /* Enable Timer 0 FIQ interrupts */
 EIC_FIQChannelConfig(T0TIMI_FIQChannel, ENABLE);
...
}
```

EIC_IRQChannelPriorityConfig

Function Name	EIC_IRQChannelPriorityConfig
Function Prototype	`void EIC_IRQChannelPriorityConfig( IRQChannel_TypeDef IRQChannel, u8 Priority);`
Behavior Description	Configures the selected IRQ channel priority.
Input Parameter 1	*IRQChannel*: the channel to be configured. Refer to *IRQ channel enumeration on page 54* for details on allowed values of *IRQChannel* parameter.
Input Parameter 2	*Priority*: specifies the priority of the channel. Priority variable must take an integer value in the range [0..15]
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None
See also	*EIC_IRQConfig on page 58*, *EIC_IRQChannelConfig on page 59*

Caution: If you select a priority level equal to 0, this channel will not be served by the EIC.

Example:

This example show how to enable timer 0 global interrupts with a priority level equal to 5 .

```
{
...
 /* Set the timer 0 global interrupts priority level to 5 */
 EIC_IRQChannelPriorityConfig(T0TIMI_IRQChannel, 0x05);
...
 /* Enable interrupts not the timer 0 global interrupts channel
*/
 EIC_IRQChannelConfig(T0TIMI_IRQChannel, ENABLE);
...
 /* Enable IRQ interrupts */
 EIC_IRQConfig(ENABLE);
...
}
```

EIC_CurrentPriorityLevelValue

Function Name	EIC_CurrentPriorityLevelValue
Function Prototype	`u8 EIC_CurrentPriorityLevelValue(void);`
Behavior Description	Returns the current priority level of the current served IRQ routine.
Input Parameter	None
Output Parameter	None
Return Value	The current priority level
Required Preconditions	None
Called Functions	None
See also	*EIC_CurrentPriorityLevelConfig on page 62*

Example:

This example shows how to get the priority level of the current interrupt service routine:

```
{
 vu8 bCurrentPriorityLevelValue;
 /* Get the current served IRQ channel priority level.*/
 bCurrentPriorityLevelValue = EIC_CurrentPriorityLevelValue();
}
```

EIC_CurrentPriorityLevelConfig

Function Name	EIC_CurrentPriorityLevelConfig
Function Prototype	`void EIC_CurrentPriorityLevelConfig(` `  u8 NewPriorityLevel);`
Behavior Description	This function changes the current priority level of the served IRQ routine.
Input Parameter	*NewPriorityLevel*: specifies the new priority level. It must be an integer in the range [0..15].
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None
See also	*EIC_CurrentPriorityLevelValue on page 62*

Note: 1 This function changes the current priority level, but doesn't change the channel priority level.

2 If this function is used in an interrupt service routine, the new priority level must be higher than the current priority level.

3 To decrease the current priority level you must ensure that all pending bits are cleared.

4 If the EIC_Init() function is used after the EIC_CurrentPriorityLevelConfig() function the current priority level is reset to zero.

Caution: If this function is used in a non interrupt service routine, all IRQ channels with a priority level lower or equal to the new priority level will be disabled.

Examples:

The current priority level is increased by 1.

```
void an_IRQ_Routine(void)
{
...

EIC_CurrentPriorityLevelConfig(EIC_CurrentPriorityLevelValue()+
1);
...
}
```

This example shows how to disable all *IRQ* channel with a priority level lower or equal to 3.

```
int main(void)
{
...
 EIC_CurrentPriorityLevelConfig(3);
...
}
```

EIC_CurrentIRQChannelValue

Function Name	EIC_CurrentIRQChannelValue
Function Prototype	`IRQChannel_TypeDef EIC_CurrentIRQChannelValue(void);`
Behavior Description	Returns the current served IRQ channel number.
Input Parameter	None
Output Parameter	None
Return Value	The current served IRQ channel number. Refer to *IRQ channel enumeration on page 54* for details on allowed values of *IRQChannel* parameter.
Required Preconditions	None
Called Functions	None

Example:

This example shows how to get the current *IRQ* channel level value.

```
{
IRQChannel_TypeDef bCurrentIRQChannelValue;
  bCurrentIRQChannelValue = EIC_CurrentIRQChannelValue();
}
```

EIC_CurrentFIQChannelValue

Function Name	EIC_FIQChannelValue
Function Prototype	`FIQChannel_TypeDef EIC_CurrentFIQChannelValue(void);`
Behavior Description	This function gets and return the current served FIQ channel number
Input Parameter	None
Output Parameter	None
Return Value	The current served FIQ channel number. Refer to *FIQ channel enumeration on page 55* for details on allowed values of *FIQChannel* parameter.
Required Preconditions	None
Called Functions	None
See also	*EIC_FIQPendingBitClear on page 65*

Note: When you use both Timer 0 and Watchdog Timer FIQ interrupts in your application, this function is required in the FIQ interrupts service routine for software prioritization and to define which FIQ pending bit you have to clear.

Example:

This example shows how to use the *EIC_FIQChannelValue* function in the *FIQ* interrupts service routine to define the source of *FIQ* interrupts.

```
void FIQ_Handler(void)
{
 switch (EIC_CurrentFIQChannelValue())
 {
    case T0TIMI_FIQChannel:
         TIM0->SR &= ~0x2000; // Clear the Timer 0 interrupt flag
          /* Clear the corresponding FIQ pending bit */
          EIC_FIQPendingBitClear(T0TIMI_FIQChannel);
          /*............User code............*/
          break;
    case WDG_FIQChannel:
          WDG->SR = 0x0000; /* Clear the WDG interrupt flag */
          /* Clear the corresponding FIQ pending bit */
          EIC_FIQPendingBitClear(WDG_FIQChannel);
          /*............User code............*/
          break;
    case WDGT0TIMI_FIQChannels:
          WDG->SR = 0x000;   /* Clear the WDG interrupt flag */
         TIM0->SR &= ~0x2000; // Clear the Timer 0 interrupt flag
          /* Clear the FIQ pending bits */
          EIC_FIQPendingBitClear(WDGT0TIMI_FIQChannels);
          /*............User code............*/
          break;
  }
}
```

EIC_FIQPendingBitClear

Function Name	EIC_FIQPendingBitClear
Function Prototype	`void EIC_FIQPendingBitClear(FIQChannel_TypeDef FIQChannel);`
Behavior Description	Clears the selected *FIQ* Pending bit located in *FIR* register by writing 1 to the corresponding bit.
Input Parameter	*FIQChannel*: specifies the *FIQ* channel to be configured. Refer to *FIQ channel enumeration on page 55* for details on allowed values of *FIQChannel* parameter.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None
See also	*EIC_CurrentFIQChannelValue on page 64*

Example:

This example shows how to use of the *EIC_FIQPendingBitClear* function in the *FIQ* interrupts service routine to define the source of *FIQ* interrupts.

```
void FIQ_Handler(void)
{
   TIM0->SR &= ~0x2000; /* Clear the Timer 0 interrupt flag */
   /* Clear the corresponding FIQ pending bit */
   EIC_FIQPendingBitClear(T0TIMI_FIQChannel);
}
```

3.5 General purpose input output (GPIO)

The GPIO driver may be used for several purposes, including pin configuration, reading a port pin and writing data into the port pin.

The first section describes the data structure used in the GPIO firmware library. The second section presents the GPIO firmware library functions.

3.5.1 Data structures

GPIO register structure

The GPIO peripheral register structure *GPIO_TypeDef* is defined in the file *71x_map.h* as follows:

```
typedef struct
{
  vu16 PC0;
  vu16 EMPTY1;
  vu16 PC1;
  vu16 EMPTY2;
  vu16 PC2;
  vu16 EMPTY3;
```

```
  vu16 PD;
  vu16 EMPTY4;
} GPIO_TypeDef;
```

Table 29 describes the *GPIO* registers.

Table 29. GPIO registers

Register	Description
PC0	Port Configuration Register 0
PC1	Port Configuration Register 1
PC2	Port Configuration Register 2
PD	Data Register

GPIO peripheral is declared in the *71x_map.h* file as follows:

```
/* APB2 Base Address definition*/
#define APB2_BASE 0xE0000000

/* GPIO0 and GPIO1 Base Address definitions*/
#define GPIO0_BASE (APB2_BASE + 0x3000)
#define GPIO1_BASE (APB2_BASE + 0x4000)
#define GPIO2_BASE (APB2_BASE + 0x5000)

/* GPIO0 and GPIO1 peripherals declaration*/
#ifndef DEBUG
#ifdef _GPIO0
  #define GPIO0              ((GPIO_TypeDef *)GPIO0_BASE)
#endif /*GPIO0*/

#ifdef _GPIO1
  #define GPIO1              ((GPIO_TypeDef *)GPIO1_BASE)
#endif /*GPIO1*/

#ifdef _GPIO2
  #define GPIO2              ((GPIO_TypeDef *)GPIO2_BASE)
#endif /*GPIO2*/
...
#else  /* DEBUG */
#ifdef _GPIO0
    EXT GPIO_TypeDef         *GPIO0;
#endif /*GPIO0*/

#ifdef _GPIO1
    EXT GPIO_TypeDef         *GPIO1;
#endif /*GPIO1*/

#ifdef _GPIO2
    EXT GPIO_TypeDef         *GPIO2;
#endif /*GPIO2*/
...
#endif
```

When debug mode is used, *GPIO* pointer is initialized in *71x_lib.c* file:

```
#ifdef _GPIO0
  GPIO0 = (GPIO_TypeDef *)GPIO0_BASE;
#endif

#ifdef _GPIO1
  GPIO1 = (GPIO_TypeDef *)GPIO1_BASE;
#endif

#ifdef _GPIO2
  GPIO2 = (GPIO_TypeDef *)GPIO2_BASE;
#endif
```

In debug mode the following variables are defined in *71x_conf.h* file:

- *_GPIO* is defined to include the *GPIO* library
- *_GPIO0*, *_GPIO1* and *_GPIO2* are defined to access the peripheral registers.

```
#define TQFP144
#define _GPIO
#define _GPIO0
#define _GPIO1

#ifdef TQFP144
#define _GPIO2
#endif /*TQFP144*/
```

GPIO pin mode enumeration

The following enumeration defines the different possible pin modes for *GPIO* peripheral. *GpioPinMode_TypeDef* enumeration is defined in *71x_gpio.h* file:

```
typedef enum
{
  GPIO_HI_AIN_TRI,
  GPIO_IN_TRI_TTL,
  GPIO_IN_TRI_CMOS,
  GPIO_IPUPD_WP,
  GPIO_OUT_OD,
  GPIO_OUT_PP,
  GPIO_AF_OD,
  GPIO_AF_PP
} GpioPinMode_TypeDef;
```

Table 30 describes the pin modes.

Table 30. GPIO pin modes

Pin mode	Description
GPIO_HI_AIN_TRI	High impedance Analog Input Tristate
GPIO_IN_TRI_TTL	Input Tristate TTL
GPIO_IN_TRI_CMOS	INPUT Tristate CMOS
GPIO_IPUPD_WP	Input Pull-Up/Pull-Down Configuration
GPIO_OUT_OD	Open Drain Output

Table 30. GPIO pin modes (continued)

Pin mode	Description
GPIO_OUT_PP	Push-Pull Output
GPIO_AF_OD	Open Drain Output Alternate-Function
GPIO_AF_PP	Push-Pull Output Alternate-Function

3.5.2 Common parameter values

Port pin values

Table 31 shows the *Port_Pins* parameter value for each pin.

Table 31. Port_Pins parameter value

Port_Pin value	Corresponding pin
0x0001	Port pin number 0
0x0002	Port pin number 1
0x0004	Port pin number 2
0x0008	Port pin number 3
0x0010	Port pin number 4
0x0020	Port pin number 5
0x0040	Port pin number 6
0x0080	Port pin number 7
0x0100	Port pin number 8
0x0200	Port pin number 9
0x0400	Port pin number 10
0x0800	Port pin number 11
0x1000	Port pin number 12
0x2000	Port pin number 13
0x4000	Port pin number 14
0x8000	Port pin number 15

GPIOx values

Table 32 shows the allowed values of *GPIOx* variable.

Table 32. GPIOx values

GPIOx	Description
GPIO0	To select *GPIO* 0
GPIO1	To select *GPIO* 1
GPIO2	To select *GPIO* 2

3.5.3 Firmware library functions

Table 33 enumerates the different functions of the *GPIO* library.

Table 33. GPIO library functions

Function Name	Description
GPIO_Config	Configures the selected GPIO I/O pins according to the input passed in parameter
GPIO_BitRead	Returns a port pin value depending on the input passed parameters
GPIO_ByteRead	Reads the specified data port byte (upper or lower eight bits) and returns its value
GPIO_WordRead	Reads the specified data port and returns its value
GPIO_BitWrite	Sets or clears the selected data port bit
GPIO_ByteWrite	Writes a byte value into the selected port register byte (upper or lower eight bits)
GPIO_WordWrite	Writes a word value into the selected port register

GPIO_Config

Function Name	GPIO_Config
Function Prototype	`void GPIO_Config (GPIO_TypeDef *GPIOx, u16 Port_Pins, GpioPinMode_TypeDef GPIO_Mode);`
Behavior Description	Configures the selected GPIO I/O pins according to the input passed parameters. Refer to the datasheet for more details on input modes, output modes and port names.
Input Parameter 1	*GPIOx*: selects the port to be configured. *x* can be 0, 1 or 2. Refer to *GPIOx values on page 68* for details on the allowed values of this parameter.
Input Parameter 2	*Port_Pins*: this parameter specifies the port pin placement. You can select more than one pin. Refer to *Port pin values on page 68* for more details on the allowed values of this parameter.
Input Parameter 3	*GPIO_Mode*: specifies the pin mode. Refer to *GPIO pin mode enumeration on page 67* for more information on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Note: 1 When you change a port pin mode, the other port pins modes stay unchanged.

2 You can configure more than one pin of the same GPIO peripheral. It is not possible to configure pins of more than one GPIO peripheral at the same call of GPIO_Config function. Moreover it is not possible to configure more than one pin of the same GPIO peripheral in more than one mode by calling once the GPIO_Config function.

Example:

This example illustrates how to configure *GPIO0*, *GPIO1* and *GPIO2* port pins.

```
{
 #define GPIO_PIN4 0x04
 #define GPIO_PIN5 0x05
/*Configure the GPIO0 pin 0 as Open Drain Output */
 GPIO_Config (GPIO0, 0x0001, GPIO_OUT_OD);

 /*Configure the GPIO0 pins 4 and 5 as a Push-Pull Output */
 GPIO_Config (GPIO0, (0x0001<<GPIO_PIN4) | (0x0001<<GPIO_PIN5),
GPIO_OUT_PP);

 /*Configure the GPIO0 pin 15 as standard TTL input */
 GPIO_Config (GPIO0, 0x8000, GPIO_IN_TRI_TTL);

 /*Configure the GPIO1 pins 0, 1, 2 and 3 as High impedance
Analog Input *
 GPIO_Config (GPIO1, 0x000F, GPIO_HI_AIN_TRI);

 /* Configure all the GPIO2 pins as Push-Pull Output */
 GPIO_Config (GPIO2, 0xFFFF, GPIO_OUT_PP);
}
```

GPIO_BitRead

Function Name	GPIO_BitRead
Function Prototype	`u8 GPIO_BitRead (GPIO_TypeDef *GPIOx, u8 Port_Pin);`
Behavior Description	Reads the specified data port bit and returns its value.
Input Parameter 1	*GPIOx*: selects the port to be read. *x* can be 0, 1 or 2. Refer to *GPIOx values on page 68* for details on the allowed values of this parameter.
Input Parameter 2	Port_Pin: Specifies the pin to see the value. Refer to *Port pin values on page 68* for more details on this parameter.
Output Parameter	None
Return Value	The selected port pin value. It may be 0x00 if the port pin is reset or 0x01 if the port pin is set.
Required preconditions	The port pin must be configured as GPIO*_IN_TRI_TTL* or as *GPIO_IN_TRI_CMOS* mode.
Called Functions	None
See also	*GPIO_ByteRead on page 71*, *GPIO_WordRead on page 72*

Example:

In This example, the values of *GPIO0* port pin 0, *GPIO1* port pin 2 and *GPIO2* port pin 15 are read.

```
{
 vu8 bValue;

 /* Get the P0.0 bit value */
 bValue = GPIO_BitRead (GPIO0,0);

 /* Get the P1.2 bit value */
 bValue = GPIO_BitRead (GPIO1, 2);

 /* Get the P2.15 bit value */
 bValue = GPIO_BitRead (GPIO2, 15);
}
```

GPIO_ByteRead

Function Name	GPIO_ByteRead
Function Prototype	`u8 GPIO_ByteRead (GPIO_TypeDef *GPIOx, u8 Port_Byte);`
Behavior Description	Reads the specified data port byte and returns its value.
Input Parameter 1	*GPIOx*: selects the port to be configured. *x* can be 0, 1 or 2. Refer to *GPIOx values on page 68* for details on the allowed values of this parameter.
Input Parameter 2	*Port_Byte*: specifies which byte to be read (upper or lower eight bits) . It must be one of the following: – *GPIO_MSB* corresponds to the upper byte – *GPIO_LSB* corresponds to the lower byte.
Output Parameter	None
Return Value	The selected port byte value
Required preconditions	The port pin must be configured as *GPIO_IN_TRI_TTL* or as *GPIO_IN_TRI_CMOS* mode.
Called Functions	None
See also	*GPIO_BitRead on page 70*, *GPIO_WordRead on page 72*

Example:

In This example *GPIO0* port lower byte and *GPIO1* port upper byte values are read.

```
{
 vu8 bValue;

 /* Get P0.[0:7] bits value */
 bValue = GPIO_ByteRead (GPIO0, GPIO_LSB);

 /* Get P1.[8:15] bits value */
 bValue = GPIO_ByteRead (GPIO1, GPIO_MSB);
}
```

GPIO_WordRead

Function Name	GPIO_WordRead
Function Prototype	`u16 GPIO_WordRead (GPIO_TypeDef *GPIOx);`
Behavior Description	Reads the value of the specified *GPIOx PD* data port register and returns its value.
Input Parameter	*GPIOx*: selects the port to be read. *x* can be 0, 1 or 2. Refer to *GPIOx values on page 68* for details on the allowed values of this parameter.
Output Parameter	None
Return Value	The specified port data value
Required preconditions	The port pin must be configured as *IN_TRI_TTL* or as *IN_TRI_CMOS* mode.
Called Functions	None
See also	*GPIO_BitRead on page 70*, *GPIO_ByteRead on page 71*

Example:

This example illustrates how to read the *GPIO0* port pin values.

```
{
 u16 wValue;

 /* Get all P0 pin value */
 wValue = GPIO_WordRead (GPIO0);
}
```

GPIO_BitWrite

Function Name	GPIO_BitWrite
Function Prototype	`void GPIO_BitWrite (GPIO_TypeDef *GPIOx, u8 Port_Pin, u8 Bit_val);`
Behavior Description	Sets or clears the selected data port bit
Input Parameter 1	*GPIOx*: selects the port. *x* can be 0, 1 or 2. Refer to *GPIOx values on page 68* for details on the allowed values of this parameter.
Input Parameter 2	*Port_Pin*: Specifies the pin to set or clear the value. Refer to *Port pin values on page 68* for more details on this parameter.
Input Parameter 3	*Bit_Val*: the value to be written 0: clear the port pin 1: set the port pin
Output Parameter	None
Return Value	None
Required preconditions	The port pin must be configured as *OUT_OD* or as *OUT_PP*.
Called Functions	None
See also	*GPIO_ByteWrite on page 74*, *GPIO_WordWrite on page 75*

Note: 1 When a port pin value is changed, the other port pins values stay unchanged.

2 The Input Pull Up/Pull Down Configuration may change according to the related input pin value.

Example:

This example shows how to clear the *GPIO* port pin 0 and sets the *GPIO1* port pin 15.

```
{
 /* Clear the P0.0 bits */
 GPIO_BitWrite(GPIO0, 0, 0);

 /* Set the P1.15 bits */
 GPIO_BitWrite(GPIO1, 15, 1);
}
```

GPIO_ByteWrite

Function Name	GPIO_ByteWrite
Function Prototype	`void GPIO_ByteWrite (GPIO_TypeDef *GPIOx, u8 Port_Byte, u8 Port_Val);`
Behavior Description	Write byte value to the selected GPIOx PD register.
Input Parameter 1	*GPIOx*: selects the port. *x* can be 0, 1 or 2. Refer to *GPIOx values on page 68* for details on the allowed values of this parameter.
Input Parameter 2	*Port_Byte*: specifies which byte to be written. It must be one of the following: – *GPIO_MSB* corresponds to the upper byte – *GPIO_LSB* corresponds to the lower byte.
Input Parameter 3	*Port_Val*: the value of the byte to be written.
Output Parameter	None
Return Value	None
Required preconditions	The port pin must be configured as *OUT_OD* or as *OUT_PP*.
Called Functions	None
See also	*GPIO_BitWrite on page 73*, *GPIO_WordWrite on page 75*

Note: 1 When a port byte value is changed, the other port byte value stay unchanged.

2 The Input Pull Up/Pull Down Configuration may change according to the related input pin value.

Example:

This example shows how to set all the *GPIO0[0:7]* port pins and clear all the *GPIO1[8:15]* port pins. the *GPIO0[8:15]* and *GPIO1[0:7]* remain unchanged.

```
{
 /*Set all the GPIO0[0:7] port pins. */
 GPIO_ByteWrite(GPIO0, GPIO_LSB, 0xFF);

 /* Clear all the GPI1[8:15] port pins */
 GPIO_ByteWrite(GPIO1, GPIO_MSB, 0x00);
}
```

GPIO_WordWrite

Function Name	GPIO_WordWrite
Function Prototype	`void GPIO_WordWrite (GPIO_TypeDef *GPIOx, u16 Port_Val);`
Behavior Description	Writes a value in to the selected data port register.
Input Parameter 1	*GPIOx*: selects the port. *x* can be 0, 1 or 2. Refer to *GPIOx values on page 68* for details on the allowed values of this parameter.
Input Parameter 2	*Port_Val*: holds the word value to be written to the selected data port.
Output Parameter	None
Return Value	None
Required preconditions	The port pin must be configured as *GPIO_OUT_OD* or as *GPIO_OUT_PP*.
Called Functions	None
See also	*GPIO_BitWrite on page 73*, *GPIO_ByteWrite on page 74*

Example:

This example sets all the *GPIO0* port pins.

```
{
 /*Set all the GPIO0 port pins */
 GPIO_WordWrite(GPIO0, 0xFFFF);
}
```

3.6 External Interrupts (XTI)

The *XTI* driver may be used for several purposes, such as firmware IRQ generation, enabling and disabling interrupt lines, selecting the edge sensitivity, interrupt or Wake-up mode.

The first section describes the data structure used in the *XTI* firmware library. The second section presents the *XTI* firmware library functions.

3.6.1 Data structures

XTI register structure

The *XTI* peripheral register structure *XTI_TypeDef* is defined in the file *71x_map.h* as follows:

```
typedef volatile struct
{
  vu8  SR;
  u8  EMPTY1[7];
  vu8  CTRL;
  u8  EMPTY2[3];
  vu8  MRH;
```

```
  u8  EMPTY3[3];
  vu8  MRL;
  u8  EMPTY4[3];
  vu8  TRH;
  u8  EMPTY5[3];
  vu8  TRL;
  u8  EMPTY6[3];
  vu8  PRH;
  u8  EMPTY7[3];
  vu8  PRL;
} XTI_TypeDef;
```

Table 34 describes the *XTI* registers.

Table 34. XTI registers

Register	Description
SR	Wake-Up Software Interrupt Register Low
CTRL	Wake-Up Control Register
MRH	Wake-Up Mask Register High
MRL	Wake-Up Mask Register Low
TRH	Wake-Up Trigger Register High
TRL	Wake-Up Trigger Register Low
PRH	Wake-Up Pending Register High
PRL	Wake-Up Pending Register Low

XTI peripheral is declared in the *71x_map.h* file as follows

```
/* APB2 Base Address definition */
#define APB2_BASE 0xE0000000

/* XTI Base Address definition */
#define XTI_BASE        (APB2_BASE + 0x101C)

/* XTI peripheral pointer declaration*/
#ifndef DEBUG
  EXT XTI_TypeDef *XTI;
   ...
#else
  #define XTI ((XTI_TypeDef *) XTI_BASE)
  ...
#endif
```

When debug mode is used, *XTI* pointer is initialized in *71x_lib.c* file:

```
#ifdef _XTI
  XTI = (XTI_TypeDef *)XTI_BASE;
#endif /* _XTI */
```

In debug mode, *_XTI* must be defined, in *71x_conf.h* file, to include the *XTI* library

```
#define _XTI
```

Wake-up line mode

The following enumeration defines the input wake-up line modes. *XTIMode_TypeDef* enumeration is defined in *71x_xti.h* file:

```
typedef enum
{
  XTI_WakeUp = 1,
  XTI_Interrupt,
  XTI_WakeUpInterrupt
} XTIMode_TypeDef;
```

Table 35 describes the *XTI* modes.

Table 35. XTI modes

Pin mode	Description
XTI_WakeUp	The interrupt lines are used to Wake Up the system from the STOP mode.
XTI_Interrupt	The interrupt lines are used to generate an IRQ interrupt on the XTI channel.
XTI_WakeUpInterrupt	Interrupt lines are used to generate an IRQ interrupt on the XTI channel and to wake up the system from the STOP mode.

Trigger edge polarity

The following enumeration defines the values of the trigger edge polarity. *XTITriggerEdge_TypeDef* enumeration is defined in *71x_xti.h* file:

```
typedef enum
{
  XTI_FallingEdge,
  XTI_RisingEdge
} XTITriggerEdge_TypeDef;
```

Table 36 lists the trigger edge polarity values.

Table 36. Trigger edge polarity values

Trigger Edge Polarity	Description
XTI_FallingEdge	The Wake-Up interrupt will be set on the falling edge
XTI_RisingEdge	The Wake-Up interrupt will be set on the rising edge

3.6.2 Common parameter values

Lines

Table 37 shows the *Lines* parameter value for each interrupt line.

Table 37. Lines values

Lines value	Corresponding Line
XTI_Line0	Line 0: Software interrupt
XTI_Line1	Line 1: *USB* wake-up event
XTI_Line2	Line 2: External interrupt

Table 37. Lines values (continued)

Lines value	Corresponding Line
XTI_Line3	Line 3: External interrupt
XTI_Line4	Line 4: External interrupt
XTI_Line5	Line 5: External interrupt
XTI_Line6	Line 6: *CAN* module receive pin
XTI_Line7	Line 7: *HDLC* clock or *I2C0* clock
XTI_Line8	Line 8: *HDLC* receive pin or *I2C0* Data
XTI_Line9	Line 9: *BSPI0* slave input data or *UART3* receive data input
XTI_Line10	Line 10: *BSPI0* slave input serial clock or *I2C1* clock
XTI_Line11	Line 11: *BSPI1* Slave input serial clock
XTI_Line12	Line 12: *UART0* receive data input
XTI_Line13	Line 13: *UART1* receive data input
XTI_Line14	Line 14: *UART2* receive data input
XTI_Line15	Line 15: WakeUp pin or *RTC* ALARM

3.6.3 Firmware library functions

Table 38 enumerates the different functions of the *XTI* library.

Table 38. XTI library functions

Function Name	Description
XTI_Init	Initializes the *XTI* to the default configuration
XTI_ModeConfig	Enables or disables the Interrupt and Wake-Up modes
XTI_LineModeConfig	Selects the line trigger edge polarity
XTI_LineConfig	Enables or disables the selected line interrupt
XTI_InterruptLineValue	Returns the wake-up line number that generates the interrupt
XTI_PendingBitClear	Clears the *XTI* pending bit
XTI_SWIRQGenerate	Generates a software *IRQ* interrupt on the *XTI* channel

XTI_Init

Function Name	XTI_Init
Function Prototype	`void XTI_Init(void);`
Behavior Description	This routine is used to initialize the XTI cell: – All Wake-Up Lines are disabled – Interrupt disabled – Walk-up mode disabled – Set on the falling edge of the input wake-up line – All pending bits are cleared
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to initialize the *XTI.*

```
{
...
 /* Initialize the XTI */
 XTI_Init();
...
}
```

XTI_ModeConfig

Function Name	XTI_ModeConfig
Function Prototype	`void XTI_ModeConfig(XTIMode_TypeDef Mode, FunctionalState NewState);`
Behavior Description	This function is used to enable or disable the interrupt and the wake-up mode of the specified input line.
Input Parameter 1	*Mode*: this parameter specifies the input line. Refer to *Wake-up line mode on page 77* for more details on the allowed values of this parameter.
Input Parameter 2	*NewState*: Used to enable or disable the selected mode. – *ENABLE*: enables the selected mode – *DISABLE*: disables the selected mode.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to enable and disable Interrupt and Wake-up modes.

```
{
 / * Disable the Interrupt and WakeUp modes */
 XTI_ModeConfig(XTI_WakeUpInterrupt, DISABLE)
 /* Enable Interrupt mode */
 XTI_ModeConfig(XTI_Interrupt, ENABLE)
}
```

XTI_LineModeConfig

Function Name	XTI_LineModeConfig
Function Prototype	`void XTI_LineModeConfig(u16 Lines, XTITriggerEdge_TypeDef TriggerEdge);`
Behavior Description	This routine is used to configure the trigger edge.
Input Parameter 1	*Lines*: this parameter specifies the input wake-up line. You can select more than one line, by logically OR'ing them. Refer to *Section 3.6.2: Common parameter values on page 77* for details on the allowed values of *Lines* parameter.
Input Parameter 2	*TriggerEdge*: specifies the trigger edge polarity of the specified wake-up lines. Refer to *Trigger edge polarity on page 77* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example shows how to set on the rising edge of the input wake-up line 3 and set on the falling edge of the input wake-up lines 1 and 2.

```
{
 /* Configure the line 3 edge */
 XTI_LineModeConfig(XTI_Line3, XTI_RisingEdge);
 /* Configure the lines 2 and 1 edge */
 XTI_LineModeConfig(XTI_Line2|XTI_Line1, XTI_FallingEdge);
}
```

XTI_LineConfig

Function Name	XTI_LineConfig
Function Prototype	`void XTI_LineConfig(u16 Lines, FunctionalState NewState);`
Behavior Description	This routine is used to enable and disable the interrupts lines.
Input Parameter 1	*Lines*: specifies the lines to be configured. You can select more than one line, by logically OR'ing them. Refer to *Section 3.6.2: Common parameter values on page 77* for details on the allowed values of *Lines* parameter.
Input Parameter 2	*NewStatus*: the input line interrupt new status to be set. – *ENABLE*: to enable the input line interrupt – *DISABLE*: to disable the input line interrupt
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example shows how to enable the line 2 and 1 Wake-Up interrupts and disable the line 3 Wake-Up interrupts.

```
{
 XTI_LineConfig(XTI_Line3, DISABLE);
 XTI_LineConfig(XTI_Line2 | XTI_Line1, ENABLE);
}
```

XTI_InterruptLineValue

Function Name	XTI_InterruptLineValue
Function Prototype	`u16 XTI_InterruptLineValue(void);`
Behavior Description	Gets and returns the input line number that generates an Interrupt.
Input Parameter	None
Output Parameter	None
Return Value	The line number that generates the interrupt.
Required preconditions	None
Called Functions	None

Example:

This example shows how to get the line number that generates the Wake-Up interrupt.

```
void XTI_IRQHandler(void)
{
 u16 wInterruptLine;
 // Read the line number that generates the interrupt.
 wInterruptLine = XTI_InterruptLineValue();
}
```

XTI_PendingBitClear

Function Name	XTI_PendingBitClear
Function Prototype	`void XTI_PendingBitClear(u16 Lines);`
Behavior Description	This routine is used to clear the XTI interrupt pending bits.
Input Parameter	*Lines*: specifies the input wake-up lines interrupt the input wake-up lines interrupt. You can select more than one line by logically OR'ing them. Refer to *Section 3.6.2: Common parameter values on page 77* for details on the allowed values of *Lines* parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to clear the pending bits in the XTI.

```
void XTI_IRQHandler(void)
{
    /* Read the line number that caused the interrupt, then
       clear the pending bit. */
    XTI_PendingBitClear(XTI_InterruptLineValue());
}
```

XTI_SWIRQGenerate

Function Name	XTI_SWIRQGenerate
Function Prototype	`void XTI_SWIRQGenerate(void);`
Behavior Description	This routine is used to generate a software IRQ interrupt.
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example generates an IRQ interrupt in the XTI channel.

```
int main(void)
{
 /*Enable interrupts in the XTI */
 XTI_ModeConfig(Interrupt, ENABLE);
 /*Configure the XTI channel priority level */
 EIC_IRQChannelPriorityConfig(XTI_IRQChannel, 1);
 /* Enable XTI interrupts */
 EIC_IRQChannelConfig(XTI_IRQChannel, ENABLE);
 /* Enable IRQ interrupts */
```

```
 EIC_IRQConfig(ENABLE);
 /* Generate a software IRQ interrupt */
 XTI_SWIRQGenerate();
}
```

3.7 Real time clock (RTC)

The *RTC* driver may be used for a variety of purposes, including real time clock management and precise timing operations.

The first section describes the data structures used in the *RTC* firmware library. The second section presents the *RTC* firmware library functions.

3.7.1 Data structures

RTC register structure

The *RTC* register structure *RTC_TypeDef* is defined in the *71x_map.h* file as follows:

```
typedef volatile struct
{
  vu16 CRH;
  u16 EMPTY1;
  vu16 CRL;
  u16 EMPTY2;
  vu16 PRLH;
  u16 EMPTY3;
  vu16 PRLL;
  u16 EMPTY4;
  vu16 DIVH;
  u16 EMPTY5;
  vu16 DIVL;
  u16 EMPTY6;
  vu16 CNTH;
  u16 EMPTY7;
  vu16 CNTL;
  u16 EMPTY8;
  vu16 ALRH;
  u16 EMPTY9;
  vu16 ALRL;
u16 EMPTY10;
} RTC_TypeDef;
```

Table 39 describes the *RTC* structure fields.

Table 39. RTC structure fields

Register	Description
CRH	Control High register
CRL	Control Low register
PRLH	Prescaler load value High register
PRLL	Prescaler load value Low register

Table 39. RTC structure fields (continued)

Register	Description
DIVH	Prescaler Divider Value High register
DIVL	Prescaler Divider Value Low register
CNTH	Counter High register
CNTL	Counter Low register
ALRH	Alarm High register
ALRL	Alarm Low register

The *RTC* peripheral is declared in the same file:

```
...
#define RTC_BASE        0xE000D000
...
#ifndef DEBUG
...
#ifdef _RTC
  #define RTC                ((RTC_TypeDef *)RTC_BASE)
#endif /*RTC*/
...
#else  /* DEBUG */
...
#ifdef _RTC
    EXT RTC_TypeDef          *RTC;
#endif /*RTC*/
...
#endif
```

When debug mode is used, *RTC* pointer is initialized in the file *71x_lib.c*:

```
#ifdef _RTC
  RTC = (RTC_TypeDef *)RTC_BASE;
#endif
```

In debug mode, *_RTC* must be defined, in the file *71x_conf.h*, to access the peripheral registers as follows:

```
#define _RTC
```

RTC flags

The following enumeration defines the different *RTC* flags. The *RTC_FLAGS* enumeration is defined in the file *71x_rtc.h*:

```
typedef enum
{
  RTC_GIR   = 0x0008,
  RTC_OWIR  = 0x0004,
  RTC_AIR   = 0x0002,
  RTC_SIR   = 0x0001
} RTC_FLAGS;
```

Table 40 describes the states of *RTC* flags.

Table 40. RTC flags

RTC Flags	Description
RTC_GIR	RTC Global Interrupt Request flag
RTC_OWIR	RTC overflow interrupt request
RTC_AIR	RTC Alarm interrupt request
RTC_SIR	RTC Second interrupt request

RTC interrupts

The following enumeration defines the real time clock interrupts. The *RTC_IT* enumeration is declared in the file *71x_rtc.h*:

```
typedef enum
{
  RTC_GIT  = 0x0008,
  RTC_OWIT = 0x0004,
  RTC_AIT  = 0x0002,
  RTC_SIT  = 0x0001,
} RTC_IT;
```

Table 41 describes the *RTC* interrupts.

Table 41. RTC interrupts

Constant Name	Description
RTC_GIT	The RTC Global Interrupt
RTC_OWIT	The RTC overflow interrupt
RTC_AIT	The RTC Alarm interrupt
RTC_SIT	The RTC Second interrupt

3.7.2 Firmware library functions

Table 42 enumerates the different functions of the *RTC* library.

Table 42. RTC library functions

Function Name	Description
RTC_PrescalerValue	Reads and returns the prescaler value
RTC_PrescalerConfig	Configures the prescaler
RTC_CounterValue	Reads and returns the counter value
RTC_CounterConfig	Update the RTC counter value
RTC_AlarmValue	Reads and returns the Alarm time value
RTC_AlarmConfig	Configures the alarm time value
RTC_FlagStatus	Reads and returns the status of the specified *RTC* flag
RTC_FlagClear	Clears the specified *RTC* flag passed in parameter
RTC_ITConfig	Enables / Disables the specified *RTC* interrupt

Table 42. RTC library functions (continued)

Function Name	Description
RTC_ITStatus	Checks the status of the specified *RTC* interrupt
RTC_ITClear	Clears the specified *RTC* interrupt
RTC_EnterCfgMode	Enters the *RTC* configuration mode
RTC_ExitCfgMode	Exit from the configuration mode
RTC_WaitForLastTask	Waits for last task to be finished

RTC_PrescalerValue

Function Name	RTC_PrescalerValue
Function Prototype	`u32 RTC_PrescalerValue (void)`
Behavior Description	This routine gets the RTC prescaler value.
Input Parameter	None
Output Parameter	None
Return Value	The current *RTC* prescaler value
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to get the current *RTC* prescaler value:

```
{
 u32 wCurrent_Prescaler;
...
 wCurrent_Prescaler = RTC_PrescalerValue ();
...
}
```

RTC_PrescalerConfig

Function Name	RTC_PrescalerConfig
Function Prototype	`void RTC_PrescalerConfig (u32 Xprescaler);`
Behavior Description	This routine is used to configure the prescaler.
Input Parameter	*Xprescaler*: specifies the new *RTC* prescaler value.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	RTC_WaitForLastTask, RTC_EnterCfgMode and RTC_ExitCfgMode

Note: The prescaler is a 20 bit value, the RTC_PrescalerConfig truncates any value, passed in parameter, that exceeds 20 bits.

Example:

This example illustrates how to configure the *RTC* prescaler value.

```
{
 u32 wNew_Prescaler;
...
 /* Reads the previous prescaler value */
  wNew_Prescaler = RTC_PrescalerValue ();
  /* Add 0xFF */
  wNew_Prescaler += 0xFF;
 /* Configures the new prescaler value */
 RTC_PrescalerConfig (wNew_Prescaler);
...
}
```

RTC_CounterValue

Function Name	RTC_CounterValue
Function Prototype	`u32 RTC_CounterValue (void);`
Behavior Description	This routine gets the current RTC counter value.
Input Parameter	None
Output Parameter	None
Return Value	The current *RTC* counter value
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to get the *RTC* counter value.

```
{
 u32 wCounter;
 ...
  wCounter = RTC_CounterValue();
...
}
```

RTC_CounterConfig

Function Name	RTC_CounterConfig
Function Prototype	`void RTC_CounterConfig (void);`
Behavior Description	This routine is used to update the RTC counter with a new value.
Input Parameter	The new *RTC* counter value
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	RTC_EnterCfgMode, RTC_WaitForLastTask and RTC_ExitCfgMode

Example:

This example illustrates how to update the *RTC* counter with 0x23F value.

```
{
 ...
  RTC_CounterConfig(0x23F);
 ...
}
```

RTC_AlarmValue

Function Name	RTC_AlarmValue
Function Prototype	`u32 RTC_AlarmValue (void);`
Behavior Description	This routine gets the current RTC alarm value.
Input Parameter	None
Output Parameter	None
Return Value	The current *RTC* alarm value (u32 format)
Required preconditions	None
Called Functions	None

Example:

```
This example illustrates how to read the current RTC alarm
value.
{
 u32 wCurrent_Alarm_Time;
...
 wCurrent_Alarm_Time = RTC_AlarmValue ();
...
}
```

RTC_AlarmConfig

Function Name	RTC_AlarmConfig
Function Prototype	`void RTC_AlarmConfig (u32 Xalarm);`
Behavior Description	This routine sets the alarm time value. It updates *AHI* & *ALO* register values.
Input Parameter	*Xalarm*: specifies the new *RTC* alarm time value.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	RTC_WaitForLastTask, RTC_EnterCfgMode and RTC_ExitCfgMode.

Example:

This example illustrates how to configure a new alarm time.

```
{
 u32 wAlarm_Time;
...
 wAlarm_Time = 0x007FFFFF;
...
 RTC_AlarmConfig (wAlarm_Time);
...
}
```

RTC_FlagStatus

Function Name	RTC_FlagStatus
Function Prototype	`FlagStatus RTC_FlagStatus (RTC_FLAGS Xflag);`
Behavior Description	This routine is used to check if the specified *RTC* flag is set or not.
Input Parameter	*Xflag*: Designates an *RTC* flag. Refer to *RTC flags on page 85* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	The specified flag status: – *SET*: The corresponding flag is SET – *RESET*: The corresponding flag is RESET
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to check the *RTC* Second interrupt flag.

```
{
...
 /* Test if the Second interrupt request is set */
 if (RTC_FlagStatus (RTC_SIR))
 {
  ...
}
}
```

RTC_FlagClear

Function Name	RTC_FlagClear
Function Prototype	`void RTC_FlagClear (RTC_FLAGS Xflag);`
Behavior Description	This routine is used to clear the specified *RTC* flag.
Input Parameter	*Xflag*: Designates an *RTC* flag. Refer to *RTC flags on page 85* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	RTC_WaitForLastTask, RTC_EnterCfgMode and RTC_ExitCfgMode

Example:

This example illustrates how to clear an *RTC* pending flag.

```
{
 /* Clear the Alarm request pending flag */
 RTC_FlagClear (RTC_AIR);
}
```

RTC_ITConfig

Function Name	RTC_ITConfig
Function Prototype	`void RTC_ITConfig (RTC_IT Xrtcit,` `  FunctionalState NewState);`
Behavior Description	This routine is used to enable or disable the specified *RTC* interrupt.
Input Parameter 1	*Xrtcit*: Designates an *RTC* interrupts. Refer to *RTC interrupts on page 86* for more details on the allowed values of this parameter.
Input Parameter 2	*NewState*: designates the new interrupt status. – *ENABLE*: The corresponding interrupt is enabled – *DISABLE*: The corresponding interrupt is disabled
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to enable the *RTC* second interrupt.

```
{
 /* Enable the global interrupt */
 RTC_ITConfig (RTC_GIT, ENABLE);
 /* Enable the Second interrupt */
 RTC_ITConfig (RTC_SIT, ENABLE);
}
```

RTC_ITStatus

Function Name	RTC_ITStatus
Function Prototype	`FunctionalState RTC_ITStatus (RTC_IT Xrtcit);`
Behavior Description	This routine checks whether the specified *RTC* interrupt is enabled or not. It reads and returns the *CRH* flags status.
Input Parameter	*Xrtcit*: Designates an *RTC* interrupts. Refer to *RTC interrupts on page 86* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	The interrupt status: – *ENABLE*: the corresponding interrupt is enabled – *DISABLE*: the corresponding interrupt is disabled
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to check the alarm interrupt status.

```
{
 /* test if the Alarm interrupt is enabled */
 if RTC_ITStatus (RTC_AIT)
 {
  ...
}
}
```

RTC_ITClear

Function Name	RTC_ITClear
Function Prototype	`void RTC_ITClear (RTC_IT Xrtcit);`
Behavior Description	This routine is used to clear the specified interrupt pending request.
Input Parameter	*Xrtcit*: designates an *RTC* interrupt. Refer to *RTC interrupts on page 86* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	RTC_WaitForLastTask, RTC_EnterCfgMode and RTC_ExitCfgMode.

Example:

This example illustrates how to clear the second interrupt request.

```
{
...
 RTC_ITClear (RTC_SIT);
...
}
```

RTC_EnterCfgMode

Function Name	RTC_EnterCfgMode
Function Prototype	`void RTC_EnterCfgMode(void);`
Behavior Description	This routine is used to enter the *RTC* configuration mode.
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	RTC_WaitForLastTask

Example:

This example illustrates how to enter in configuration mode.

```
{
...
 RTC_EnterCfgMode ();
...
}
```

RTC_ExitCfgMode

Function Name	RTC_ExitCfgMode
Function Prototype	`void RTC_ExitCfgMode(void);`
Behavior Description	This routine is used to exit from the *RTC* configuration mode.
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	RTC_WaitForLastTask

Example:

This example illustrates how to exit from configuration mode.

```
{
...
 RTC_ExitCfgMode ();
...
}
```

RTC_WaitForLastTask

Function Name	RTC_WaitForLastTask
Function Prototype	`void RTC_WaitForLastTask(void);`
Behavior Description	This routine waits for the task to be completed on the *RTC* registers.
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to use the *RTC_WaitForLastTask function*.

```
{
...
 RTC_WaitForLastTask();
...
}
```

3.8 Watchdog timer (WDG)

The *WDG* driver may be used for a variety of purposes, including timing operations and watchdog functions.

The first section describes the data structures used in the *WDG* firmware library. The second section presents the *WDG* firmware library functions.

3.8.1 Data structures

WDG register structure

The *WDG* register structure *WDG_TypeDef* is defined in the *71x_map.h* file as follows:

```
typedef volatile struct
{
  vu16 CR;
  u16 EMPTY1;
  vu16 PR;
  u16 EMPTY2;
  vu16 VR;
  u16 EMPTY3;
  vu16 CNT;
  u16 EMPTY4;
  vu16 SR;
  u16 EMPTY5;
  vu16 MR;
  u16 EMPTY6;
  vu16 KR;
u16 EMPTY7
} WDG_TypeDef;
```

Table 43 describes the *WDG* structure fields.

Table 43. WDG structure fields

Register	Description
CR	Control register
PR	Prescaler register
VR	Pre-load Value register
CNT	Counter register
SR	Status Register
MR	Mask Register
KR	Key Register

The *WDG* peripherals are declared in the same file:

```
...
#define WDG_BASE         (APB2_BASE + 0xE000)
...
#ifndef DEBUG
...
#ifdef _WDG
  #define WDG                  ((WDG_TypeDef *)WDG_BASE)
#endif /*WDG*/
...
#else  /* DEBUG */
...
#ifdef _WDG
    EXT WDG_TypeDef            *WDG;
#endif /*WDG*/
...
#endif
```

When debug mode is used, *WDG* pointers are initialized in the file *71x_lib.c*:

```
#ifdef _WDG
  WDG = (WDG_TypeDef *)WDG_BASE;
#endif
```

In debug mode, *_WDG* must be defined, in the file *71x_conf.h*, to access the peripheral registers as follows:

```
#define _WDG
```

Some *RCCU* functions are called, *_RCCU* must be defined, in *71x_conf.h* file, to make the *RCCU* functions accessible:

```
#define _RCCU
```

3.8.2 Firmware library functions

Table 44 enumerates the different functions of the *WDG* library.

Table 44. WDG library functions

Function Name	Description
WDG_Enable	Enable Watchdog Mode
WDG_CntRefresh	Refresh and update the WDG counter to avoid a system reset
WDG_PrescalerConfig	Set the counter prescaler value. Divide the counter clock by (Prescaler + 1)
WDG_CntReloadUpdate	Update the counter pre-load value
WDG_PeriodValueConfig	Set the prescaler and counter reload value based on the time needed
WDG_CntOnOffConfig	Start or stop the free auto-reload timer to countdown
WDG_ECITConfig	Enable or Disable the end of count interrupt
WDG_ECFlagClear	Clear the end of count flag
WDG_ECStatus	Return the end of count status.

WDG_Enable

Function Name	WDG_Enable
Function Prototype	`void WDG_Enable ( void );`
Behavior Description	This routine is used to enable Watchdog mode.
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to enable Watchdog mode:

```
{
...
 /* Enable the watchdog mode */
 WDG_Enable ();
...
}
```

WDG_CntRefresh

Function Name	WDG_CntRefresh
Function Prototype	`void WDG_CntRefresh (void);`
Behavior Description	This routine is used to refresh the counter to prevent a reset being generated by the Watchdog. It writes 0xA55A then 0x5AA5 in the key register.
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to refresh the watchdog counter.

```
{
...
 WDG_CntRefresh ();
...
}
```

WDG_PrescalerConfig

Function Name	WDG_PrescalerConfig
Function Prototype	`void WDG_PrescalerConfig (u8 Prescaler);`
Behavior Description	This routine is used to set the the counter prescaler value. The clock to Timer Counter is divided by (Prescaler + 1)
Input Parameter	*Prescaler*: specifies the prescaler value (8 bit).
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to set the prescaler value.

```
{
...
 WDG_PrescalerConfig (0x62);
...
}
```

WDG_CntReloadUpdate

Function Name	WDG_CntReloadUpdate
Function Prototype	`void WDG_CntReloadUpdate (u16 PreLoadValue);`
Behavior Description	This routine is used to update the counter pre-load value.
Input Parameter	*PreLoadValue* specifies the pre-load value (16 bit).
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to configure the *WDG* pre-load value.

```
{
...
 void WDG_CntReloadUpdate (0x1234);
...
}
```

WDG_PeriodValueConfig

Function Name	WDG_PeriodValueConfig
Function Prototype	`void WDG_PeriodValueConfig (u32 Time);`
Behavior Description	This routine is used to set the prescaler and counter reload value.
Input Parameter	*Time:* the amount of time needed, in microseconds.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	RCCU_FrequencyValue, FindFactors

Example:

This example illustrates how to set the needed time (µs).

```
{
...
 WDG_PeriodValueConfig (2589);
...
}
```

WDG_CntOnOffConfig

Function Name	WDG_CntOnOffConfig
Function Prototype	`void WDG_CntOnOffConfig (FunctionalState NewState);`
Behavior Description	This routine is used to start or stop the free auto-reload timer counting down.
Input Parameter	*NewState*: specifies how the timer has to be started or stopped.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to configure the *WDG* in order to start or stop the timer.

```
{
...
 /* stop the counter */
 WDG_CntOnOffConfig (DISABLE);
 /* Start the counter */
 WDG_CntOnOffConfig (ENABLE);
...
}
```

WDG_ECITConfig

Function Name	WDG_ECITConfig
Function Prototype	`void WDG_ECITConfig (FunctionalState NewState)`
Behavior Description	Enable or Disable the WDG end of count interrupt.
Input Parameter	*NewState*: specifies whether the WDG end of count interrupt is enabled or disabled. – ENABLE: enables the WDG IRQ interrupt – DISABLE: disables the WDG IRQ interrupt.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to enable the WDG end of count interrupt.

```
{
...

  WDG_ECITConfig(ENABLE);
...
}
```

WDG_ECFlagClear

Function Name	WDG_ECFlagClear
Function Prototype	`void WDG_ECFlagClear (void);`
Behavior Description	This routine is used to clear the end of count flag.
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how clear the end of count pending bit.

```
{
...
 WDG_ECFlagClear ();
...
}
```

WDG_ECStatus

Function Name	WDG_ECStatus
Function Prototype	`u16 WDG_ECStatus (void);`
Behavior Description	Read the status register.
Input Parameter	None
Output Parameter	None
Return Value	The end of count status
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to get the end of count status

```
{
...
 u16 hStatus;
 hStatus = WDG_ECStatus();
...
}
```

3.9 Timer (TIM)

The *TIM* driver may be used for a variety of purposes, including timing operations, external wave generation and measurement.

The first section describes the data structures used in the *TIM* firmware library. The second section presents the *TIM* firmware library functions.

3.9.1 Data structures

TIM register structure

The *TIM* register structure *TIM_TypeDef* is defined in the *71x_map.h* file as follows:

```
typedef volatile struct
{
  vu16 ICAR;
  u16 EMPTY1;
  vu16 ICBR;
  u16 EMPTY2;
  vu16 OCAR;
  u16 EMPTY3;
  vu16 OCBR;
  u16 EMPTY4;
  vu16 CNTR;
  u16 EMPTY5;
  vu16 CR1;
  u16 EMPTY6;
  vu16 CR2;
  u16 EMPTY7;
  vu16 SR;
u16 EMPTY8;
} TIM_TypeDef;
```

Table 45 describes the *TIM* structure fields.

Table 45. TIM structure fields

Register	Description
ICAR	Input capture A register
ICBR	Input capture B register
OCAR	Output Compare A register
OCBR	Output Compare B register
CNTR	Counter Register
CR1	Control Register 1
CR2	Control Register 2
SR	Status Register

The *TIM* peripherals are declared in the same file:

```
...
#define TIM0_BASE        (APB2_BASE + 0x9000)
#define TIM1_BASE        (APB2_BASE + 0xA000)
```

```
#define TIM2_BASE       (APB2_BASE + 0xB000)
#define TIM3_BASE       (APB2_BASE + 0xC000)
...
#ifndef DEBUG
...
#ifdef _TIM0
  #define TIM0                ((TIM_TypeDef *)TIM0_BASE)
#endif /*TIM0*/

#ifdef _TIM1
  #define TIM1                ((TIM_TypeDef *)TIM1_BASE)
#endif /*TIM1*/

#ifdef _TIM2
  #define TIM2                ((TIM_TypeDef *)TIM2_BASE)
#endif /*TIM2*/

#ifdef _TIM3
  #define TIM3                ((TIM_TypeDef *)TIM3_BASE)
#endif /*TIM3*/
...
#else  /* DEBUG */
  ...
#ifdef _TIM0
    EXT TIM_TypeDef           *TIM0;
#endif /*TIM0*/

#ifdef _TIM1
    EXT TIM_TypeDef           *TIM1;
#endif /*TIM1*/

#ifdef _TIM2
    EXT TIM_TypeDef           *TIM2;
#endif /*TIM2*/

#ifdef _TIM3
    EXT TIM_TypeDef           *TIM3;
#endif /*TIM3*/
  ...
#endif
```

When debug mode is used, *TIM* pointers are initialized in the file *71x_lib.c*:

```
#ifdef _TIM0
  TIM0 = (TIM_TypeDef *)TIM0_BASE;
#endif

#ifdef _TIM1
  TIM1 = (TIM_TypeDef *)TIM1_BASE;
#endif

#ifdef _TIM2
  TIM2 = (TIM_TypeDef *)TIM2_BASE;
#endif
```

```
#ifdef _TIM3
  TIM3 = (TIM_TypeDef *)TIM3_BASE;
#endif
   TIM0  = (TIM_TypeDef *)TIM0_BASE;
```

In debug mode, *_TIMx* must be defined in the file *71x_conf.h* to access the peripheral registers as follows:

```
#define _TIMx (x=0..3)
```

TIM values

Table 46 enumerates the different values of the TIMx.

Table 46. TIMx values

TIM Value	Description
TIM0	Timer 0
TIM1	Timer 1
TIM2	Timer 2
TIM3	Timer 3

TIM flags enumeration

The following enumeration defines the different *TIM* flags. The *TIM_Flags* enumeration is defined in the file *71x_tim.h*:

```
typedef enum
{
  TIM_ICFA = 0x8000,
  TIM_OCFA = 0x4000,
  TIM_TOF  = 0x2000,
  TIM_ICFB = 0x1000,
  TIM_OCFB = 0x0800
} TIM_Flags;
```

Table 47 describes the states of *TIM* flags.

Table 47. TIM flags

TIM Flags	Description
TIM_ICFA	*TIM* Input Capture channel A flag
TIM_OCFA	*TIM* Output Compare channel A flag
TIM_TOF	*TIM* Timer Overflow flag
TIM_ICFB	*TIM* Input Capture channel B flag
TIM_OCFB	*TIM* Output Compare channel B flag

Clock sources enumeration

The following enumeration defines the different *TIM* clock sources. The *TIM_Clocks* enumeration is defined in the file *71x_tim.h*:

```
typedef enum
{
  TIM_EXTERNAL,
  TIM_INTERNAL
} TIM_Clocks;
```

Table 48 enumerates the clock sources.

Table 48. TIM clock sources

Clock Source	Description
TIM_EXTERNAL	The *TIM* peripheral is clocked by the external clock
TIM_INTERNAL	The *TIM* peripheral is clocked by *APB* clock

Clock edges enumeration

The following enumeration defines the different *TIM* clock edges. The *TIM_Clock_Edges* enumeration is defined in the file *71x_tim.h*:

```
typedef enum
{
  TIM_RISING,
  TIM_FALLING
} TIM_Clock_Edges;
```

Table 49 enumerates the clock edges.

Table 49. TIM clock edges

clock Edge	Description
TIM_RISING	The active edge is the rising edge
TIM_FALLING	The active edge is the falling edge

TIM channels enumeration

The following enumeration defines the different *TIM* channels. The *TIM_Channels* enumeration is defined in the file *71x_tim.h*:

```
typedef enum
{
  TIM_CHANNEL_A,
  TIM_CHANNEL_B
} TIM_Channels;
```

Table 50 enumerates the TIM channels.

Table 50. TIM channels

TIM Channel	Description
TIM_CHANNEL_A	Channel A
TIM_CHANNEL_B	Channel B

Output compare modes enumeration

The following enumeration defines the Output Compare modes. The *OC_Modes* enumeration is defined in the file *71x_tim.h*:

```
typedef enum
{
 TIM_TIMING,
 TIM_WAVE
} TIM_OC_Modes;
```

Table 51 enumerates the output compare modes.

Table 51. Output compare modes

Output Compare Mode	Description
TIM_TIMING	The output compare mode is used for internal operations
TIM_WAVE	The output compare mode is only used for external wave generation operations

Logic levels enumeration

The following enumeration defines the different logic levels. The *Logic_Levels* enumeration is defined in the file *71x_tim.h*:

```
typedef enum
{
  TIM_HIGH,
  TIM_LOW
} TIM_Logic_Levels;
```

Table 52 enumerates the logic levels.

Table 52. Logic levels

Logic level	Description
TIM_HIGH	The output compare is forced to the high level after the match between the counter and the output compare register.
TIM_LOW	The output compare is forced to the low level after the match between the counter and the output compare register.

Counter operations enumeration

The following enumeration defines the different counter operations. The *CounterOperations* enumeration is defined in the file *71x_tim.h*:

```
typedef enum
{
  TIM_START,
  TIM_STOP,
  TIM_CLEAR
} TIM_CounterOperations;
```

Table 53 enumerates the counter operations.

Table 53. Counter operations

Counter Operation	Description
TIM_START	Enables or resumes the counter
TIM_STOP	Stops the TIM counter
TIM_CLEAR	Clears the TIM counter value and set its value to FFFCh

PWM input parameters structure

The following structure defines the different PWM input parameters. The *PWMI_parameters* structure is defined in the file *71x_tim.h*:

```
typedef struct
{
  u16 Pulse,
  u16 Period
} PWMI_parameters;
```

Table 54 defines the PWM input parameters.

Table 54. PWM input parameters

Structure Field	Description
Pulse	The pulse of the external signal
Period	The period of the external signal

TIM interrupts

The following section lists the different *TIM* interrupts. Those interrupts are declared in the file *71x_tim.h*:

```
#define TIM_ICA_IT   0x8000
#define TIM_OCA_IT   0x4000
#define TIM_TO_IT    0x2000
#define TIM_ICB_IT   0x1000
#define TIM_OCB_IT   0x0800
```

Table 55 describes the *TIM* interrupts.

Table 55. TIM interrupts

TIM Interrupts	Description
TIM_ICA_IT	*TIM* Input Capture Channel A interrupt
TIM_OCA_IT	*TIM* Output Compare channel A interrupt
TIM_TO_IT	*TIM* Timer Overflow interrupt
TIM_ICB_IT	*TIM* Input Capture Channel A interrupt
TIM_OCB_IT	*TIM* Output Compare channel B interrupt

3.9.2 Firmware library functions

Table 56 enumerates the different functions of the *TIM* library.

Table 56. TIM library functions

Function Name	Description
TIM_Init	Initializes the *TIM* peripheral
TIM_ClockSourceConfig	Configures the *TIM* clock source
TIM_ClockSourceValue	Gets the *TIM* clock source
TIM_PrescalerConfig	Configures the *TIM* prescaler Value
TIM_PrescalerValue	Gets the *TIM* prescaler Value
TIM_ClockLevelConfig	Configures the active clock level when the *TIM* is clocked by an external source
TIM_ClockLevelValue	Gets the active clock level when the *TIM* is clocked by an external source
TIM_ICAPModeConfig	Configures the Input capture mode
TIM_ICAPValue	Gets the Input capture values
TIM_OCMPModeConfig	Configures the Output compare mode
TIM_OPModeConfig	Configures the One pulse mode
TIM_PWMOModeConfig	Configures the PWM output mode
TIM_PWMIModeConfig	Configures the PWM input mode
TIM_PWMIValue	Reads and returns the PWM input parameters
TIM_ITConfig	Configures the *TIM* interrupts
TIM_FlagStatus	Gets the *TIM* flag Status
TIM_FlagClear	Clears the *TIM* pending flag
TIM_CounterConfig	Configures the *TIM* counter
TIM_CounterValue	This routine returns the timer counter value.

TIM_Init

Function Name	TIM_Init
Function Prototype	`void TIM_Init (TIM_TypeDef *TIMx);`
Behavior Description	This routine is used to Initialize the TIM peripheral registers to their default values.
Input Parameter	*TIMx* specifies the *TIM* to be initialized. Refer to *TIM values on page 103* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to initialize all the *TIM* peripherals:

```
{
...
 /* Initialize the TIM0 peripheral */
 TIM_Init (TIM0);
 /* Initialize the TIM1 peripheral */
 TIM_Init (TIM1);
 /* Initialize the TIM2 peripheral */
 TIM_Init (TIM2);
/*Initialize the TIM3 peripheral */
 TIM_Init (TIM3);
...
}
```

TIM_ClockSourceConfig

Function Name	TIM_ClockSourceConfig
Function Prototype	`void TIM_ClockSourceConfig (TIM_TypeDef *TIMx, TIM_Clocks Xclock);`
Behavior Description	This routine configures the source clock of the *TIM* peripheral.
Input Parameter 1	*TIMx:* specifies the *TIM* to be configured. Refer to *TIM values on page 103* for more details on the allowed values of this parameter.
Input Parameter 2	*Xclock* specifies the *TIM* source clock. Refer to *Clock sources enumeration on page 104* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to configure the *TIM0* timer to be clocked by an external source.

```
{
...
 TIM_ClockSourceConfig (TIM0, TIM_EXTERNAL);
...
}
```

TIM_ClockSourceValue

Function Name	TIM_ClockSourceValue
Function Prototype	`TIM_Clocks TIM_ClockSourceValue TIM_TypeDef *TIMx);`
Behavior Description	This routine gets the source clock of the *TIM* peripheral.
Input Parameter	*TIMx:* specifies the TIM to check its source clock. Refer to *TIM values on page 103* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	The *TIM* source clock. Refer to *Clock sources enumeration on page 104* for more details on the allowed values of this parameter.
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to get the *TIM0* timer source clock.

```
{
 TIM_Clocks CurrentTIMClock;
...
 CurrentTIMClock = TIM_ClockSourceValue (TIM0);
...
}
```

TIM_PrescalerConfig

Function Name	TIM_PrescalerConfig
Function Prototype	`void TIM_PrescalerConfig (TIM_TypeDef *TIMx, u8 Xprescaler);`
Behavior Description	This routine configures the *TIM* prescaler value to divide the internal clock.
Input Parameter 1	*TIMx* specifies the *TIM* to be configured. Refer to *TIM values on page 103* for more details on the allowed values of this parameter.
Input Parameter 2	*Xprescaler*: specifies the *TIM* prescaler value (8bit).
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to configure the *TIM3* prescaler.

```
{
...
 TIM_PrescalerConfig (TIM3, 0x5);
...
}
```

TIM_PrescalerValue

Function Name	TIM_PrescalerValue
Function Prototype	`u8 TIM_PrescalerValue (TIM_TypeDef *TIMx);`
Behavior Description	This routine gets the *TIM* prescaler value when the internal clock is used.
Input Parameter	*TIMx:* specifies the timer to get its prescaler value. Refer to *TIM values on page 103* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	The Current *TIM* prescaler Value (8bit).
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to get the *TIM2* prescaler value.

```
{
 vu8 bCurrentPrescaler;
...
 bCurrentPrescaler = TIM_PrescalerConfig (TIM2);
...
}
```

TIM_ClockLevelConfig

Function Name	TIM_ClockLevelConfig
Function Prototype	`void TIM_ClockLevelConfig (TIM_TypeDef *TIMx, Clock_Levels Xlevel);`
Behavior Description	This routine configures the active level when using an external clock source.
Input Parameter 1	*TIMx:* specifies the TIM to be configured. Refer to *TIM values on page 103* for more details on the allowed values of this parameter.
Input Parameter 2	*Xlevel*: specifies the active edge of the external clock. Refer to *Clock edges enumeration on page 104* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to configure the *TIM0* to be clocked by an external clock source and the active edge to falling edge.

```
{
...
 /* Configure the Active Clock edge */
 TIM_ClockLevelConfig (TIM0, TIM_FALLING);
 /* Configure the TIM0 source clock */
 TIM_ClockSourceConfig (TIM0, TIM_EXTERNAL)
...
}
```

TIM_ClockLevelValue

Function Name	TIM_ClockLevelValue
Function Prototype	`Clock_Levels TIM_ClockLevelValue (TIM_TypeDef *TIMx);`
Behavior Description	This routine gets and returns the clock active level when using an external clock source.
Input Parameter	*TIMx:* specifies the TIM to be configured. Refer to *TIM values on page 103* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	The external clock level of the specified timer. Refer to *Clock edges enumeration on page 104* for more details on the allowed values of this parameter.
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to get the current clock level of the *TIM0*.

```
{
...
TIM_Clock_Edges CurrentLevel;
 CurrentLevel = TIM_ClockLevelValue (TIM0);
...
}
```

TIM_ICAPModeConfig

Function Name	TIM_ICAPModeConfig
Function Prototype	`void TIM_ICAPModeConfig (TIM_TypeDef *TIMx, TIM_Channels Xchannel, Clock_Edges Xedge);`
Behavior Description	This routine is used to configure the Input capture mode.
Input Parameter 1	*TIMx* specifies the *TIM* to be initialized. Refer to *TIM values on page 103* for more details on the allowed values of this parameter.
Input Parameter 2	*Xchannel*: specifies the input capture channels. Refer to *TIM channels enumeration on page 104* for more details on the allowed values of this parameter.
Input Parameter 3	*Xedge*: specifies the input capture sensitive edge. Refer to *Clock edges enumeration on page 104* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to configure the *TIM3* input capture channel A to detect Rising edge.

```
{
...
 TIM_ICAPModeConfig (TIM3, TIM_CHANNEL_A, TIM_RISING);
...
}
```

TIM_ICAPValue

Function Name	TIM_ICAPValue
Function Prototype	`u16 TIM_ICAPValue (TIM_TypeDef *TIMx, TIM_Channels Xchannel);`
Behavior Description	This routine gets the input capture value.
Input Parameter 1	*TIMx:* specifies the TIM to check its Input Capture value. Refer to *TIM values on page 103* for more details on the allowed values of this parameter.
Input Parameter 2	*Xchannel*: specifies the Input Capture channel. Refer to *TIM channels enumeration on page 104* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	The input capture value of the specified timer and channel
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to get the input capture value of the *TIM3*.

```
{
...
 u16 hICAPValue;
 hICAPValue = TIM_ICAPValue (TIM3, TIM_CHANNEL_A);
...
}
```

TIM_OCMPModeConfig

Function Name	TIM_OCMPModeConfig
Function Prototype	`void TIM_OCMPModeConfig ( TIM_TypeDef *TIMx, TIM_Channels Xchannel, u16 XpulseLength, TIM_OC_Modes Xmode, TIM_Logic_Levels Xlevel);`
Behavior Description	This routine is used to configure the output compare mode.
Input Parameter 1	*TIMx* specifies the *TIM* to be initialized. Refer to *TIM values on page 103* for more details on the allowed values of this parameter.
Input Parameter 2	*Xchannel*: specifies the output compare channel. Refer to *TIM channels enumeration on page 104* for more details on the allowed values of this parameter.
Input Parameter 3	*XpulseLength*: specifies the pulse length.
Input Parameter 4	*Xmode*: specifies the output compare mode: Refer to *Output compare modes enumeration on page 105* for more details on the allowed values of this parameter.
Input Parameter 5	*Xlevel*: specifies the level of the external signal after the match occurs: Refer to *Logic levels enumeration on page 105* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to configure the *TIM3* output compare channel A to generate an external wave which toggle from low level to high level after 0x7FFF timer period.

```
{
...
 TIM_OCMPModeConfig (TIM3, TIM_CHANNEL_A, 0x7FFF, TIM_WAVE,
TIM_HIGH)
...
}
```

TIM_OPModeConfig

Function Name	TIM_OPModeConfig

Function Prototype	`void TIM_OPModeConfig (TIM_TypeDef *TIMx,`
	`u16 XpulseLength,`
	`TIM_Logic_Levels XLevel1,`
	`TIM_Logic_Levels XLevel2,`
	`TIM_Clock_Edges Xedge);`

Behavior Description	This routine is used to configure the one pulse mode.
Input Parameter 1	*TIMx* specifies the TIM to be configured. Refer to *TIM values on page 103* for more details on the allowed values of this parameter.
Input Parameter 2	*XpulseLength*: specifies the pulse length.
Input Parameter 3	*XLevel1*: specifies the output level on the OCMPA pin during the pulse. Refer to *Logic levels enumeration on page 105* for more details on the allowed values of this parameter.
Input Parameter 4	*XLevel2*: specifies the output level on the OCMPB pin after the pulse. Refer to *Logic levels enumeration on page 105* for more details on the allowed values of this parameter.
Input Parameter 5	*Xedge*: specifies the edge to be detected by the input capture A pin. Refer to *Clock edges enumeration on page 104* for more details on the allowed values of this parameter. – *TIM_RISING*: a rising edge will activate the one pulse mode – *TIM_FALLING*: a falling edge will activate the one pulse mode
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to configure the *TIM3* one pulse mode to generate an external wave with a pulse length of 0xABC in terms of timer period. The pulse generation is activated by a rising edge on the input capture A pin.

```
{
...
 TIM_OPModeConfig (TIM3, 0xABC, TIM_HIGH, TIM_LOW, TIM_RISING);
...
}
```

TIM_PWMOModeConfig

Function Name	TIM_PWMOModeConfig
Function Prototype	`void TIM_PWMOModeConfig (TIM_TypeDef *TIMx, u16 XDutyCycle, TIM_Logic_Levels XLevel1, u16 XFullperiod, TIM_Logic_Levels XLevel2);`
Behavior Description	This routine is used to configure the PWM output mode.
Input Parameter 1	*TIMx* specifies the *TIM* to be initialized. Refer to *TIM values on page 103* for more details on the allowed values of this parameter.
Input Parameter 2	*XDutyCycle*: specifies the PWM signal duty cycle.
Input Parameter 3	*XLevel1*: specifies the PWM signal level during the duty cycle. Refer to *Logic levels enumeration on page 105* for more details on the allowed values of this parameter.
Input Parameter 4	*XFullperiod*: specifies the PWM signal full period.
Input Parameter 5	*XLevel2*: specifies the PWM signal level out of the duty cycle. Refer to *Logic levels enumeration on page 105* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to configure the *TIM3* to generate a PWM with a period of 0xFFF timer period and a duty cycle of 50%.

```
{
...
 TIM_PWMOModeConfig (TIM3, 0x7FF, TIM_HIGH, 0xFFF, TIM_LOW);
...
}
```

TIM_PWMIModeConfig

Function Name	TIM_PWMIModeConfig
Function Prototype	`void TIM_PWMIModeConfig (TIM_TypeDef *TIMx, TIM_Clock_Edges Xedge);`
Behavior Description	This routine is used to configure the PWM input mode.
Input Parameter 1	*TIMx* specifies the *TIM* to be initialized. Refer to *TIM values on page 103* for more details on the allowed values of this parameter.
Input Parameter 2	*Xedge*: specifies the first edge of the external PWM signal. Refer to *Clock edges enumeration on page 104* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to configure the *TIM3* to measure an external PWM signal.

```
{
...
 TIM_PWMIModeConfig (TIM3, TIM_RISING);
...
}
```

TIM_PWMIValue

Function Name	TIM_PWMIValue
Function Prototype	`PWMI_parameters TIM_PWMIValue (TIM_TypeDef *TIMx);`
Behavior Description	This routine is used to configure the PWM input mode.
Input Parameter	*TIMx* specifies the *TIM* to be initialized. Refer to *TIM values on page 103* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	The PWM input parameters: pulse and period. Refer to *PWM input parameters structure on page 106* for more details on the allowed values of this parameter.
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to get the PWM input signal parameters.

```
{
...
 PWMI_parameters PWM_InputSignal;
 PWM_InputSignal = TIM_PWMIValue (TIM3);
...
}
```

TIM_CounterConfig

Function Name	TIM_CounterConfig
Function Prototype	`void TIM_CounterConfig (TIM_TypeDef *TIMx, CounterOperations Xoperation);`
Behavior Description	This routine is used to start/stop and clear the selected timer counter
Input Parameter 1	*TIMx* specifies the *TIM* to be initialized. Refer to *TIM values on page 103* for more details on the allowed values of this parameter.
Input Parameter 2	*Xoperation*: specifies the operation of the counter. Refer to *Counter operations enumeration on page 105* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to stop the *TIM3* counter.

```
{
...
 TIM_CounterConfig (TIM3, TIM_STOP);
...
}
```

TIM_CounterValue

Function Name	TIM_CounterValue
Function Prototype	`u16 TIM_CounterValue(TIM_TypeDef *TIMx)`
Behavior Description	This routine returns the timer counter value.
Input Parameter 1	*TIMx:* specifies the TIM to get its counter value. Refer to *TIM values on page 103* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	The selected timer counter value
Required preconditions	None
Called Functions	None

Example:

This example illustrates how get the *TIM0* timer counter value.

```
{
u16 wTIMCounterValue;
...
 wTIMCounterValue = TIM_CounterValue (TIM0);
...
}
```

TIM_ITConfig

Function Name	TIM_ITConfig
Function Prototype	`void TIM_ITConfig (TIM_TypeDef *TIMx, u16 New_IT, FunctionalState NewState);`
Behavior Description	This routine is used to configure the *TIM* interrupt.
Input Parameter 1	*TIMx:* specifies the TIM to be configured. Refer to *TIM values on page 103* for more details on the allowed values of this parameter.
Input Parameter 2	*New_IT*: specifies the TIM interrupt to be configured. You can specify one or more TIM interrupts to be configured using the logical operator 'OR'. Refer to *TIM interrupts on page 106* for more details on the allowed values of this parameter.
Input Parameter 3	*NewState*: specifies the TIM interrupt state whether it would be enabled or disabled. – *ENABLE*: the corresponding TIM interrupt(s) will be enabled – *DISABLE*: the corresponding TIM interrupt(s) will be disabled
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to enable the *TIM3* overflow and input capture A interrupts.

```
{
...
 TIM_ITConfig (TIM3, TIM_TO_IT | TIM_ICA_IT, ENABLE);
...
}
```

TIM_FlagStatus

Function Name	TIM_FlagStatus
Function Prototype	`FlagStatus TIM_FlagStatus (TIM_TypeDef *TIMx, TIM_Flags Xflag);`
Behavior Description	This routine is used to check a*TIM* flag status.
Input Parameter 1	*TIMx:* specifies the *TIM* to check a flag. Refer to *TIM values on page 103* for more details on the allowed values of this parameter.
Input Parameter 2	Xflag: specifies the TIM flag to be tested. Refer to *TIM flags enumeration on page 103* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	The flag status passed in parameter.
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to check whether the Timer overflow interrupt of the *TIM3* is set.

```
{
...
 FlagStatus TOF_Status;
 TIM_FlagStatus = TIM_FlagStatus (TIM3, TIM_TOF);
...
}
```

TIM_FlagClear

Function Name	TIM_FlagClear
Function Prototype	`void TIM_FlagClear (TIM_TypeDef *TIMx, TIM_Flags Xflag)`
Behavior Description	This routine is used to clear the *TIM* flags.
Input Parameter 1	*TIMx:* specifies the TIM to clear a flag. Refer to *TIM values on page 103* for more details on the allowed values of this parameter.
Input Parameter 2	Xflag: specifies the TIM flag to be cleared. Refer to *TIM flags enumeration on page 103* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to clear the Timer overflow interrupt flag.

```
{
...
 TIM_FlagClear (TIM3, TIM_TOF);
...
}
```

3.10 Buffered serial peripheral interface (BSPI)

The *BSPI* driver may be used for a variety of purposes including allowing several external peripherals to be linked through an *SPI* protocol bus.

The first section describes the data structures used in the *BSPI* firmware library. The second section presents the *BSPI* firmware library functions

3.10.1 Data structures

BSPI register structure

The *BSPI* peripheral register structure *BSPI_TypeDef* is defined in the file *71x_map.h* as follows:

```
typedef struct
{
  vu16 RXR;
  u16 EMPTY1;
  vu16 TXR;
  u16 EMPTY2;
  vu16 CSR1;
  u16 EMPTY3;
  vu16 CSR2;
  u16 EMPTY4;
  vu16 CLK;
u16 EMPTY5;
} BSPI_TypeDef;
```

Table 57 describes the *BSPI* registers.

Table 57. BSPI registers

Register	Description
RXR	Receive Register
TXR	Transmit Register
CSR1	Control/Status Register 1
CSR2	Control/Status Register 2
CLK	Master Clock Divider Register

The two *BSPI* interfaces are declared in the same file *71x_map.h*:

```
 /* APB1 Base Address definition*/
#define APB1_BASE       0xC0000000

/* BSPI Base Address definition*/
#define BSPI0_BASE      (APB1_BASE + 0xA000)
#define BSPI1_BASE      (APB1_BASE + 0xB000)

/* BSPI peripheral pointer declaration*/
#ifndef DEBUG
...
#ifdef _BSPI0
  #define BSPI0               ((BSPI_TypeDef *)BSPI0_BASE)
#endif /*BSPI0*/

#ifdef _BSPI1
  #define BSPI1               ((BSPI_TypeDef *)BSPI1_BASE)
#endif /*BSPI1*/
...
#else /*DEBUG */
...
```

```
#ifdef _BSPI0
    EXT BSPI_TypeDef          *BSPI0;
#endif /*BSPI0*/

#ifdef _BSPI1
    EXT BSPI_TypeDef          *BSPI1;
#endif /*BSPI1*/...
#endif
```

When debug mode is used, *BSPI* pointer is initialized in *71x_lib.c* file:

```
 #ifdef _BSPI0
   BSPI0 = (BSPI_TypeDef *)BSPI0_BASE;
 #endif /* _BSPI0 */
#ifdef _BSPI1
   BSPI1 = (BSPI_TypeDef *)BSPI1_BASE;
 #endif /* _BSPI1 */
```

In debug mode, *_BSPI0* and *_BSPI1* must be defined, in *71x_conf.h* file, to access the peripheral registers as follows:

```
#define _BSPI
#define _BSPI0
#define _BSPI1
...
```

BSPI flags

The following enumeration defines the *BSPI* flags. *BSPI_Flags* enumeration is defined in the file *71x_bspi.h*:

```
typedef enum {
                BSPI_BERR =   0x04,
                BSPI_RFNE =   0x08,
                BSPI_RFF  =   0x10,
                BSPI_ROFL =   0x20,
                BSPI_TFE  =   0x40,
                BSPI_TUFL =   0x80,
                BSPI_TFF  =   0x100,
                BSPI_TFNE =   0x200
              } BSPI_Flags;
```

Table 58 describes the BSPI flags.

Table 58. BSPI flags

BSPI Register	Register Offset	Flag	Flag Index	Flag Code
BSP_SR2	0x0C	*BSPI_BERR*: Bus error flag	2	0x04
		BSPI_RFNE: Receive FIFO not empty flag	3	0x08
		BSPI_RFF: Receive FIFO full flag	4	0x10
		BSPI_ROFL: Receive overflow flag	5	0x20
		BSPI_TFE: Transmit FIFO empty flag	6	0x40
		BSPI_TUFL: Transmit underflow flag	7	0x80
		BSPI_TFF: Transmit FIFO full flag	8	0x100
		BSPI_TFNE: Transmit FIFO not empty flag	9	0x200

BSPI interrupts

The following enumeration defines the *BSPI* interrupts. The *BSPI_ITS_ERR* is defined in the file *71x_bspi.h* as follows:

```
typedef enum
{
  BSPI_BEIE = 0x80,
  BSPI_REIE = 0x10,
  BSPI_ALL_ERR = 0x90
} BSPI_IT_ERR;
```

Table 59 enumerates the *BSPI* interrupts.

Table 59. BSPI interrupts

BSPI Interrupt Flags	Description
BSPI_BEIE	Bus Error Interrupt
BSPI_REIE	Receive Error Interrupt
BSPI_ALL_ERR	All Error interrupts: *BSPI_BEIE* and *BSPI_REIE*

Transmit interrupt sources

The following enumeration defines the *BSPI* transmit interrupt sources. The *TR_IT_SRCS* is defined in the file *71x_bspi.h* as follows:

```
typedef enum
{
  BSPI_TR_FE,
  BSPI_TR_UFL,
  BSPI_TR_FF,
  BSPI_TR_DIS
 } BSPI_IT_TR;
```

Table 60 enumerates the *BSPI* transmit interrupt sources.

Table 60. BSPI transmit interrupt sources

Transmit interrupt source	Description
BSPI_TR_FE	Transmit FIFO empty
BSPI_TR_UFL	Transmit underflow
BSPI_TR_FF	Transmit FIFO full
BSPI_TR_DIS	All interrupts disabled

Receive interrupt sources

The following enumeration defines the *BSPI* receive interrupt sources. The *RC_IR_SRCS* is defined in the file *71x_bspi.h* as follows:

```
typedef enum
{
  BSPI_RC_FNE,
  BSPI_RC_FF,
  BSPI_RC_DIS
 } BSPI_IT_RC;
```

Table 61 enumerates the *BSPI* receive interrupt sources.

Table 61. BSPI receive interrupt sources

Receive interrupt source	Description
BSPI_RC_FNE	Receive FIFO not empty
BSPI_RC_FF	Receive FIFO full
BSPI_RC_DIS	All interrupts disabled

3.10.2 Firmware library functions

Table 62 enumerates the different functions of the *BSPI* library.

Table 62. BSPI library functions

Function Name	Description
BSPI_BSPI0Conf	Enable or disable *BSPI0* interface
BSPI_Init	Initializes *BSPI* peripheral control and registers to their default reset values.
BSPI_Enable	Enables/disables the specified *BSPI* peripheral
BSPI_MasterEnable	Selects or deselects *BSPI* master mode
BSPI_TrItSrc	Configures the transmit interrupt source
BSPI_RcItSrc	Configures the receive interrupt source
BSPI_TrFifoDepth	Configures the number of the words for the *BSPI* transmit *FIFO*

Table 62. BSPI library functions (continued)

Function Name	Description
BSPI_RcFifoDepth	Configures the number of the words for the *BSPI* receive *FIFO*
BSPI_8bLEn	Sets the word length to 8 or 16 bits
BSPI_ClkFEdge	Enables capturing the first data sample on the first edge of *SCK* or on the second edge
BSPI_ClkActiveHigh	Configures the clock to be active high or low
BSPI_FifoDisable	Disables *BSPI FIFO*
BSPI_ClockDividerConfig	Configures *BSPI* clock divider
BSPI_FlagStatus	Checks whether the specified Flag is set or not
BSPI_WordSend	Transmits a single word of data
BSPI_WordReceive	Returns the recent received word
BSPI_ByteBufferSend	Transmits 8 bits data from a buffer
BSPI_ByteBufferReceive	Returns the recent 8 bits data received
BSPI_WordBufferSend	Transmits 16 bits of data from a buffer
BSPI_WordBufferReceive	Returns the recent 16 bits data received
BSPI_ErrItSrc	Enables the specified error interrupt

BSPI_BSPI0Conf

Function Name	BSPI_BSPI0Conf
Function Prototype	`void BSPI_BSPI0Conf(FunctionalState NewState);`
Description	Configure BSPI0 to be available on GPIO0.0 to GPIO0.3 pins.
Input Parameter	NewState: specified the status of the BSPI0. – *ENABLE*: BSPI0 interface will be enabled. – *DISABLE*: BSPI0 interface will be enabled
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to enable the *BSPI0* interface:

```
{
  ...
  BSPI_BSPI0Conf (ENABLE);
  ...
}
```

BSPI_Init

Function Name	BSPI_Init
Function Prototype	`void BSPI_Init (BSPI_TypeDef *BSPIx);`
Behavior Description	Initializes *the BSPI* peripheral control and registers to their default reset values.
Input Parameter	BSPIx: selects the BSPI peripheral to be initialized where x can be 0 or 1.
Output Parameters	None
Return Value	None
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to initialize the *BSPI0*:

```
{
...
 BSPI_Init (BSPI0);
...
}
```

BSPI_Enable

Function Name	BSPI_Enable
Function Prototype	`void BSPI_Enable (BSPI_TypeDef *BSPIx, FunctionalState NewState);`
Behavior Description	Enables/disables the specified BSPI peripheral.
Input Parameter 1	BSPIx: selects the BSPI peripheral to be enabled or disabled where x can be 0 or 1.
Input Parameter 2	NewState: specifies the status of the *BSPI*. – *ENABLE*: the specified *BSPI* peripheral will be enabled. – *DISABLE*: the specified *BSPI* peripheral will be disabled.
Output Parameter	None
Return Value	None
Required Preconditions	I/O ports should be configured in their reset states and clock divider must be configured
Called Functions	None

Example:

This example illustrates how to enable and disable the *BSPI0* interface:

```
{
...
 /*Configures BSPI clock divider */
 BSPI_ClockDividerConfig(BSPI0, 8);
```

```
...
 /*Enable BSPI0 peripheral */
 BSPI_Enable (BSPI0, ENABLE);
...
 /*User code */
...
 /* Disable BSPI0 peripheral */
 BSPI_Enable (BSPI0, DISABLE);
...
}
```

BSPI_MasterEnable

Function Name	BSPI_MasterEnable
Function Prototype	`void BSPI_MasterEnable (BSPI_TypeDef *BSPIx, FunctionalState NewState);`
Behavior Description	Configures the *BSPI* as a Master or a Slave.
Input Parameter 1	*BSPIx*: selects the BSPI peripheral to be configured as master or slave where x can be 0 or 1.
Input Parameter 2	*NewState*: specifies whether *BSPI* will be configured as master or slave. – *ENABLE*: the specified *BSPI* will be configured as a master. – *DISABLE*: the specified *BSPI* will be configured as a slave.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to configure the *BSPI0* as a master or a slave

```
{
...
 /* Enable BSPI0 interface */
 BSPI_BSPI0Conf (ENABLE);
...

...
 /*Configure BSPI0 as a master */
 BSPI_MasterEnable (BSPI0, ENABLE);
...
/*Enable BSPI0 peripheral */
 BSPI_Enable (BSPI0, ENABLE);
...
}
```

BSPI_TrItSrc

Function Name	BSPI_TrItSrc
Function Prototype	`void BSPI_TrITSrc(BSPI_TypeDef *BSPIx, TR_IT_SRCS TrItSrc);`
Behavior Description	Configures the transmit interrupt source.
Input Parameter 1	*BSPIx*: selects the BSPI peripheral to be configured where x can be 0 or 1.
Input Parameter 2	*TrItSrc*: specifies the transmit interrupt source. Refer to *Transmit interrupt sources on page 123* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required Preconditions	*BSPI* system must be enabled
Called Functions	None

Example:

This example illustrates how to configure the transmit interrupt source in the *BSPI0* peripheral:

```
{
  ...
  /*Enable BSPI0 peripheral */
  BSPI_Enable (BSPI0, ENABLE);
  ...
  /*Enable BSPI0 to generate an interrupt when a transmit
underflow occurs */
  BSPI_TrItSrc(BSPI0, BSPI_TR_UFL);
  ...
}
```

BSPI_RcItSrc

Function Name	BSPI_RcItSrc
Function Prototype	`void BSPI_RcItSrc (BSPI_TypeDef *BSPIx, RC_IT_SRCS RcItSrc);`
Behavior Description	Configures the receive interrupt source.
Input Parameter 1	*BSPIx*: selects the BSPI peripheral to be configured where x can be 0 or 1.
Input Parameter 2	*RcItSrc*: specifies the source for the receive interrupt. Refer to *Receive interrupt sources on page 124* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required Preconditions	*BSPI* system must be enabled
Called Functions	None

Example:

This example illustrates how to configure the receive interrupt source in the *BSPI0* peripheral:

```
{
  ...
  /*Enable BSPI0 peripheral */
  BSPI_Enable (BSPI0, ENABLE);
  ...

  /*Enable BSPI0 to generate an interrupt when the FIFO is not
empty */
  BSPI_RcItSrc (BSPI0, BSPI_RC_FNE);
  ...
}
```

BSPI_TrFifoDepth

Function Name	BSPI_TrFifoDepth
Function Prototype	`void BSPI_TrFifoDepth(BSPI_TypeDef *BSPIx, u8 TDepth);`
Behavior Description	Configures the depth of the BSPI transmission FIFO.
Input Parameter 1	*BSPIx*: selects the BSPI peripheral to be configured where x can be 0 or 1.
Input Parameter 2	*TDepth*: specifies the depth of the transmit FIFO.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to set the depth of the transmit *FIFO* to 8 words:

```
{
  ...
  BSPI_TrFifoDepth(BSPI0, 8);
  ...
}
```

BSPI_RcFifoDepth

Function Name	BSPI_RcFifoDepth
Function Prototype	`void BSPI_RcFifoDepth(BSPI_TypeDef *BSPIx, u8 RDepth);`
Behavior Description	Configures the depth of the BSPI reception FIFO.
Input Parameter 1	*BSPIx:* selects BSPI peripheral to be configured where x can be 0 or 1.
Input Parameter 2	*RDepth*: specifies the depth of the receive *FIFO*.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to set the depth of the receive *FIFO* to 5 words:

```
{
  ...
  BSPI_RcFifoDepth(BSPI0, 5);
  ...
}
```

BSPI_8bLEn

Function Name	BSPI_8bLEn
Function Prototype	`void BSPI_8bLEn(BSPI_TypeDef *BSPIx, FunctionalState NewState);`
Behavior Description	Sets the word length of the receive FIFO and transmit data registers to either 8 or 16 bits.
Input Parameter 1	*BSPIx:* selects BSPI peripheral to be configured where x can be 0 or 1.
Input Parameter 2	NewState: specifies if the word length is 8 or 16 bits. – *ENABLE*: enables setting the word length to 8 bits – *DISABLE*: disables setting the word length to 8 bits: the word length will be set to 16 bits
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to set word length to16 bits for the *BSPI0* peripheral:

```
{
  ...
  BSPI_8bLEn(BSPI0, DISABLE);
  ...
}
```

BSPI_ClkFEdge

Function Name	BSPI_ClkFEdge
Function Prototype	`void BSPI_ClkFEdge (BSPI_TypeDef *BSPIx, FunctionalState NewState);`
Behavior Description	Enables capturing the first data sample on the first edge of *SCK* or on the second edge.
Input Parameter 1	*BSPIx*: selects BSPI peripheral to be configured where x can be 0 or 1.
Input Parameter 2	NewState: specifies whether capturing the first data sample on the first edge of *SCK* is enabled or disabled. – *ENABLE*: enables capturing the first data sample on the first edge of *SCK* – *DISABLE*: enables capturing the first data sample on the second edge of *SCK*
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to configure *BSPI0* to capture the first data sample on the first edge of *SCK*:

```
{
  ...
      BSPI_ClkFEdge (BSPI0, ENABLE);
  ...
}
```

BSPI_ClkActiveHigh

Function Name	BSPI_ClkActiveHigh
Function Prototype	`void BSPI_ClkActiveHigh (BSPI_TypeDef *BSPIx, FunctionalState NewState);`
Behavior Description	Configures the clock to be active high or low.
Input Parameter 1	*BSPIx*: selects BSPI peripheral to be configured where x can be 0 or 1.
Input Parameter 2	*Status*: specifies whether the clock is active high or low. – *ENABLE*: configures the clock to be active high – *DISABLE*: configures the clock to be active low
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to configure *BSPI0* clock to be active high:

```
{
  BSPI_ClkActiveHigh (BSPI0, ENABLE);
  ...
}
```

BSPI_FifoDisable

Function Name	BSPI_FifoDisable
Function Prototype	`void BSPI_FifoDisable (BSPI_TypeDef *BSPIx);`
Behavior Description	Disables the FIFO of the specified BSPI.
Input Parameter	*BSPIx*: selects BSPI peripheral to be configured where x can be 0 or 1.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to disable the *BSPI0 FIFO*:

```
{
  BSPI_FifoDisable (BSPI0);
  ...
}
```

BSPI_ClockDividerConfig

Function Name	BSPI_ClockDividerConfig
Function Prototype	`void BSPI_ClockDividerConfig (BSPI_TypeDef *BSPIx, u8 Div);`
Behavior Description	Configures *BSPI* clock divider.
Input Parameter 1	*BSPIx*: selects BSPI peripheral to be configured where x can be 0 or 1 to select the *BSPI*.
Input Parameter 2	*Div*: holds the value of the clock divider.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to set *BSPI0* clock divider to 8:

```
{
  BSPI_ClockDividerConfig (BSPI0, 8);
  ...
}
```

BSPI_FlagStatus

Function Name	BSPI_FlagStatus
Function Prototype	`FlagStatus BSPI_FlagStatus (BSPI_TypeDef *BSPIx, BSPI_Flags flag);`
Description	Checks whether the specified *BSPI* Flag is set or not.
Input Parameter 1	BSPIx: selects BSPI peripheral to be configured where x can be 0 or 1.
Input Parameter 2	*flag:* specifies the flag to see the status. Refer to *BSPI flags on page 122* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	The status of the specified flag: – *SET*: if the tested *flag* is set – *RESET*: if the tested *flag* is reset
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to test if the *BSPI0 TFE* (Transmit FIFO Empty) is set:

```
{
  FlagStatus bStatus1;
  ...
/* Get the status of the BSPI transmit Fifo not empty flag */
  bStatus1 = BSPI_FlagStatus (BSPI0, BSPI_TFE);
  ...
}
```

BSPI_WordSend

Function Name	BSPI_WordSend
Function Prototype	`void BSPI_WordSend (BSPI_TypeDef *BSPIx, u16 Data);`
Description	Transmits a single Word.
Input Parameter 1	*BSPIx*: selects BSPI peripheral to be configured where x can be 0 or 1.
Input Parameter 2	Data: the word which will be transmitted.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to use the *BSPI_WordSend* function to send a word 0x5D in the:

```
{
  ...
  /*Transmit a single Word */
BSPI_WordSend (BSPI0, 0x5D);
   ...
}
```

BSPI_ByteBufferSend

Function Name	BSPI_ByteBufferSend
Function Prototype	`void BSPI_ByteBufferSend(BSPI_TypeDef *BSPIx, u8 *PtrToBuffer, u8 NbOfWords)`
Behavior Description	Transmits 8 bit data format from a buffer.
Input Parameter 1	*BSPIx*: selects BSPI peripheral to be used where x can be 0 or 1.
Input Parameter 2	*PtrToBuffer:* is an ‘u8’ pointer to the first byte of the buffer to be transmitted.
Input Parameter 3	*NbOfWords:* the number of bytes saved in the buffer to be sent.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	BSPI_WordSend

Example:

This example illustrates how to send a buffer:

```
{
  vu8 pBuffer[] = “Hello“;
  ...
  // Transmit 5 bytes data
BSPI_ByteBufferSend (BSPI0, pBuffer, 5);
  ...
}
```

BSPI_WordBufferSend

Function Name	BSPI_WordBufferSend
Function Prototype	`void BSPI_WordBufferSend(BSPI_TypeDef *BSPIx, u16 *PtrToBuffer, u8 NbOfWords)`
Description	Transmits 16 bits data format from a buffer.
Input Parameter 1	*BSPIx*: selects BSPI peripheral to be used where x can be 0 or 1.
Input Parameter 2	PtrToBuffer: is an 'u16' pointer to the first word of the buffer to be transmitted.
Input Parameter 3	NbOfWords: indicates the number of words saved in the buffer to be sent.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	BSPI_WordSend

Example:

This example illustrates how to send a buffer:

```
{
  vu16 pBuffer[] = {0x1234,0xAAAA,0x5555};
  ...
  /*Transmit 3 16-bit data format */
BSPI_ByteBufferSend (BSPI0, pBuffer, 3);
  ...
}
```

BSPI_WordReceive

Function Name	BSPI_BufferReceive
Function Prototype	`u16 BSPI_WordReceive(BSPI_TypeDef *BSPIx);`
Description	Returns the recent received word.
Input Parameter 1	*BSPIx*: selects BSPI peripheral to be used where x can be 0 or 1.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to receive a data from the BSPI0:

```
{
u16 data;
  ...
/*Receive a data from BSPI0 */
data = BSPI_WordReceive (BSPI0);
  ...
}
```

BSPI_ByteBufferReceive

Function Name	BSPI_ByteBufferReceive
Function Prototype	`void BSPI_ByteBufferReceive(BSPI_TypeDef *BSPIx, u8 *PtrToBuffer, u8 NbOfWords)`
Description	Receives number of data words and stores them in user defined area.
Input Parameter 1	*BSPIx*:selects BSPI peripheral to be used where x can be 0 or 1.
Input Parameter 2	PtrToBuffer: is an 'u8' pointer to the first word of the defined area to save the received buffer.
Input Parameter 3	NbOfWords: indicates the number of bytes to be received in the buffer.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	BSPI_WordReceive

Example:

This example illustrates how to receive 5 word from a buffer:

```
{
  u8 pBuffer[10];
  ...
  /*Receive 5 8-bit data and stores them in user-defined area */
BSPI_ByteBufferReceive (BSPI0, pBuffer, 5);
  ...
}
```

BSPI_WordBufferReceive

Function Name	BSPI_ByteBufferReceive
Function Prototype	`void BSPI_WordBufferReceive(BSPI_TypeDef *BSPIx, u16 *PtrToBuffer, u8 NbOfWords)`
Description	Receives number of data words and stores them in user defined area.
Input Parameter 1	*BSPIx*: selects BSPI peripheral to be used where x can be 0 or 1.
Input Parameter 2	PtrToBuffer: is an 'u16' pointer to the first word of the defined area to save the received buffer.
Input Parameter 3	NbOfWords: indicates the number of words to be received in the buffer.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	BSPI_WordReceive

Example:

This example illustrates how to receive 5 word from a buffer:

```
{
  u16 pBuffer[10];
  ...
  /*Receive 5 16-bit data and stores them in user-defined area */
BSPI_WordBufferReceive (BSPI0, pBuffer, 5);
  ...
}
```

BSPI_ErrItSrc

Function Name	BSPI_ErrItSrc
Function Prototype	`void BSPI_ErrItSrc (BSPI_TypeDef *BSPIx, BSPI_IT_ERR BSPI_IE, FunctionalState NewState );`
Description	Enables or disables the specified error interrupt.
Input Parameter 1	*BSPIx*: selects BSPI peripheral to be used where x can be 0 or 1.
Input Parameter 2	*BSPI_IE*: specifies the BSPI error interrupt to be enabled or disabled. Refer to *BSPI interrupts on page 123* for more details on the allowed values of this parameter
Input Parameter 3	NewState: specified whether the *BSPI* error interrupt is enabled or disabled. – *ENABLE*: to enable interrupt. – *DISABLE*: to disable interrupt.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to enable the interrupt feature in the *BSPI0* peripheral:

```
{
  ...
BSPI_ErrItSrc (BSPI0, BSPI_BEIE, ENABLE);
  ...
}
```

3.11 Universal asynchronous receiver transmitter (UART)

The *UART* driver may be used for a variety of purposes, including mode selection, Baud rate configuration and 8 and 9-bit byte reception and transmission.

The first section describes the data structures used in the *UART* firmware library. The second section presents the *UART* firmware library functions.

3.11.1 Data structures

UART register structure

The *UART* register structure *UART_TypeDef* is defined in the *71x_map.h* file as follows:

```
typedef struct
{ vu16 BR;
  u16  EMPTY1;
  vu16 TxBUFR;
  u16  EMPTY2;
  vu16 RxBUFR;
  u16  EMPTY3;
  vu16 CR;
  u16  EMPTY4;
  vu16 IER;
  u16  EMPTY5;
  vu16 SR;
  u16  EMPTY6;
  vu16 GTR;
  u16  EMPTY7;
  vu16 TOR;
  u16  EMPTY8;
  vu16 TxRSTR;
  u16  EMPTY9;
  vu16 RxRSTR;
  u16  EMPTY10;
} UART_TypeDef;
```

Table 63 describes the *UART* structure fields.

Table 63. UART structure fields

Register	Description
BR	Baud Rate Register
TxBUFR	Transmit Buffer Register
RxBUFR	Receive Buffer Register
CR	Control Register
IER	Interrupt Enable Register
SR	Status Register
GTR	Guard Time Register
TOR	Time Out Register
TxRSTR	Tx FIFO Reset Register
RxRSTR	Rx FIFO Reset Register

The *UARTs* peripherals are declared in the same file:

```
...
#define APB1_BASE        0xC0000000
#define UART0_BASE       (APB1_BASE + 0x4000)
#define UART1_BASE       (APB1_BASE + 0x5000)
#define UART2_BASE       (APB1_BASE + 0x6000)
#define UART3_BASE       (APB1_BASE + 0x7000)
...
#ifndef DEBUG
  ...
#ifdef _UART0
  #define UART0               ((UART_TypeDef *)UART0_BASE)
#endif /*UART0*/

#ifdef _UART1
  #define UART1               ((UART_TypeDef *)UART1_BASE)
#endif /*UART1*/

#ifdef _UART2
  #define UART2               ((UART_TypeDef *)UART2_BASE)
#endif /*UART2*/

#ifdef _UART3
  #define UART3               ((UART_TypeDef *)UART3_BASE)
#endif /*UART3*/
...
#else  /* DEBUG */
  ...
#ifdef _UART0
    EXT UART_TypeDef          *UART0;
#endif /*UART0*/

#ifdef _UART1
    EXT UART_TypeDef          *UART1;
#endif /*UART1*/

#ifdef _UART2
    EXT UART_TypeDef          *UART2;
#endif /*UART2*/

#ifdef _UART3
    EXT UART_TypeDef          *UART3;
#endif /*UART3*/
...
#endif
```

When debug mode is used, the *UART* pointers are initialized in the file *71x_lib.c*:

```
#ifdef _UART0
  UART0 = (UART_TypeDef *)UART0_BASE;
#endif  /* _UART0 */
#ifdef _UART1
  UART1 = (UART_TypeDef *)UART1_BASE;
#endif /* _UART1 */
```

```
#ifdef _UART2
  UART2 = (UART_TypeDef *)UART2_BASE;
#endif /* _UART2 */
#ifdef _UART3
  UART3 = (UART_TypeDef *)UART3_BASE;
#endif /* _UART3 */
```

In debug mode, *_UART0, _UART1, _UART2* and *_UART3* must be defined, in the file *71x_conf.h*, to access the peripheral registers as follows:

```
#define _UART
#define _UART0
#define _UART1
#define _UART2
#define _UART3
```

The UART library use the *RCCU* and *PCU* library. The *_RCCU* and *_PCU* must be defined, in the *71x_conf*.h, to access the RCCU and PCU registers and library functions as follows:

```
#define _RCCU
#define _PCU
```

FIFOs

The following enumeration defines the *UART* FIFOs. The *UARTFIFO_TypeDef* enumeration is defined in the *71x_uart.h* file:

```
typedef enum
{
  UART_RxFIFO,
  UART_TxFIFO
} UARTFIFO_TypeDef;
```

Table 64 describes the *UART* FIFOs.

Table 64. UART FIFOs

Regulator State	Description
UART_RxFIFO	Receive FIFO
UART_TxFIFO	Transmit FIFO

UART stop bits

The following enumeration defines the *UART* Stop Bits selection. The *UARTStopBits_TypeDef* enumeration is declared in the *71x_uart.h* file:

```
typedef enum
{
  UART_0_5_StopBits  = 0x0000,
  UART_1_StopBits    = 0x0008,
  UART_1_5_StopBits  = 0x0010,
  UART_2_StopBits    = 0x0018
} UARTStopBits_TypeDef;
```

Table 65 describes the *UART* Stop Bits.

Table 65. UART stop bits

Stop Bits	Description
UART_0_5_StopBits	0.5 stop bits
UART_1_StopBits	1 stop bit
UART_1_5_StopBits	1.5 stop bits
UART_2_StopBits	2 stop bits

UART parity modes

The following enumeration defines the UART parity modes. The *UARTParity_TypeDef* enumeration is declared in the *71x_uart.h* file:

```
typedef enum
{
  UART_EVEN_PARITY = 0x0000,
  UART_ODD_PARITY = 0x0020,
  UART_NO_PARITY = 0x0000,
} UARTParity_TypeDef;
```

Table 66 describes the *UART* parity modes.

Table 66. UART parity modes

Parity Mode	Description
UART_NO_PARITY	No parity mode
UART_ODD_PARITY	Odd parity mode
UART_EVEN_PARITY	Even parity mode

UART modes

The following enumeration defines the *UART* modes. *WFI_CLOCKS* enumeration is declared in the *71x_uart.h* file:

```
typedef enum
{
  UARTM_8D = 0x0001,
  UARTM_7D_P = 0x0003,
  UARTM_9D = 0x0004,
  UARTM_8D_W = 0x0005,
  UARTM_8D_P = 0x0007
} UARTMode_TypeDef;
```

Table 67 lists the different *UART* modes.

Table 67. UART modes

UART Modes	Description
UARTM_8D	8-bit data (without parity) mode
UARTM_7D_P	7-bit data mode with parity
UARTM_9D	9-bit data mode (without parity)
UARTM_8D_W	8-bit data mode with wake-up bit
UARTM_8D_P	8-bit data mode with parity

Interrupt and status flags

The following definitions define the UART Interrupt and status flags. The interrupt and status flags are defined in the *71x_uart.h* file:

```
#define UART_TxFull           0x0200
#define UART_RxHalfFull       0x0100
#define UART_TimeOutIdle      0x0080
#define UART_TimeOutNotEmpty 0x0040
#define UART_OverrunError     0x0020
#define UART_FrameError       0x0010
#define UART_ParityError      0x0008
#define UART_TxHalfEmpty      0x0004
#define UART_TxEmpty          0x0002
#define UART_RxBufNotEmpty 0x0001
```

Table 68 describes the Interrupt and status flags.

Table 68. Interrupt and status flags

Interrupt and Status Flags	Description
UART_TxFull	Transmit Buffer Full (Status register only)
UART_RxHalfFull	Receiver buffer Half Full
UART_TimeOutIdle	Time-out Idle
UART_TimeOutNotEmpty	Time-out Not Empty
UART_OverrunError	Overrun Error
UART_FrameError	Framing Error
UART_ParityError	Parity Error
UART_TxHalfEmpty	Transmit buffer Half Empty
UART_TxEmpty	Transmit buffer Empty
UART_RxBufNotEmpty	Receive Buffer Not Empty

UARTx values

Table 69 shows the allowed values of *UARTx* variable.

Table 69. UARTx values

UARTx	Description
UART0	To select *UART*0
UART1	To select *UART*1
UART2	To select *UART*2
UART3	To select *UART*3

3.11.2 Firmware library functions

Table 70 enumerates the different functions of the *UART* library.

Table 70. UART library functions

Function Name	Description
UART_Init	This routine is used to initialize the selected *UART*
UART_ModeConfig	This routine configures the *UART* mode
UART_BaudRateConfig	This routine configures the baud rate of the selected *UART*
UART_ParityConfig	This routine configures the *UART* parity mode
UART_StopBitsConfig	This routine configures the number of stop bits of the selected *UART*
UART_Config	This routine configures the Baud rate, parity mode, the number of stop bits and the *UART* mode of the selected *UART*
UART_ItConfig	This routine enables/disables the interrupts sources of the selected *UART*
UART_FifoConfig	This routine enables/disables the FIFOs of the selected *UART*
UART_FifoReset	This routine resets the selected FIFO of the selected *UART*
UART_LoopBackConfig	This routine enables/disables loop back in the selected *UART*
UART_TimeOutPeriodConfig	This routine configures the time-out Period of the selected *UART*
UART_GuardTimeConfig	This routine configures the guard time of the selected *UART*
UART_RxConfig	This routine enables/disables reception on the selected *UART*
UART_OnOffConfig	This turns the selected *UART* On / Off
UART_ByteSend	This routine sends a 7-bit byte or an 8-bit byte
UART_9BitByteSend	This routine sends a 9-bit byte
UART_DataSend	This routine sends several 7-bit bytes or 8-bit bytes
UART_9BitDataSend	This routine sends several 9-bit bytes
UART_StringSend	This routine sends a 7-bit or 8-bit string
UART_ByteReceive	This routine gets a 7 or an 8-bit byte from the selected *UART*
UART_9BitByteReceive	This routine gets a 9-bit byte from the selected *UART*.
UART_DataReceive	This routine gets several 7 or 8-bit bytes from the selected *UART*

Table 70. UART library functions (continued)

Function Name	Description
UART_9BitDataReceive	This routine gets several 9-bit bytes from the selected *UART*
UART_StringReceive	This routine gets several 7- or 8-bit bytes from the selected *UART*
UART_FlagStatus	This routine return the status of the selected *UART*
SendChar	This routine sends a character to the defined UART

UART_Init

Function Name	UART_Init
Function Prototype	`void UART_Init(UART_TypeDef *UARTx);`
Behavior Description	This function initializes the selected UART registers to their reset values.
Input Parameter	*UARTx*: selects the UART to be configured. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to initialize the *UART0*:

```
{
  ...
  UART_Init(UART0);
  ...
}
```

UART_ModeConfig

Function Name	UART_ModeConfig
Function Prototype	`void UART_ModeConfig(UART_TypeDef *UARTx, UARTMode_TypeDef UART_Mode);`
Behavior Description	This routine configures the *UART* mode.
Input Parameter 1	*UARTx*: selects the *UART* to be configured. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	*UART_Mode*: selects the *UART* mode. Refer to *UART modes on page 143* for details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to configure the *UART0* mode:

```
{
  /*Configure the UART0 mode to 8 bit data without parity */
  UART_ModeConfig(UART0, UARTM_8D);
  ...
}
```

UART_BaudRateConfig

Function Name	UART_BaudRateConfig
Function Prototype	`void UART_BaudRateConfig(UART_TypeDef *UARTx, u32 BaudRate);`
Behavior Description	This routine configures the baud rate of the selected *UART*.
Input Parameter 1	*UARTx*: selects the *UART* to be configured. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	*BaudRate*: The baud rate value in bps
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	*RCCU_FrequencyValue(RCCU_PCLK1)*: gets the *APB1* frequency.

Example:

This example illustrates how to configure the *UART0* baud rate:

```
{
  /*Set the UART0 baud rate to 9600 bps */
  UART_BaudRateConfig(UART0, 9600);
  ...
}
```

UART_ParityConfig

Function Name	UART_ParityConfig
Function Prototype	`void UART_ParityConfig(UART_TypeDef *UARTx, UARTParity_TypeDef Parity);`
Behavior Description	This function configures the data parity of the selected UART.
Input Parameter 1	*UARTx*: the selected UART. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	*Parity*: the parity type. Refer to *UART parity modes on page 143* for details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to configure the *UART0* parity mode to Odd parity:

```
{
  /* Configure the UART0 parity mode to odd parity */
  UART_ParityConfig(UART0, UART_ODD_PARITY);
  ...
}
```

UART_StopBitsConfig

Function Name	UART_StopBitsConfig
Function Prototype	`void UART_StopBitsConfig(UART_TypeDef *UARTx, UARTStopBits_TypeDef StopBits);`
Behavior Description	This routine configures the number of stop bits of the selected *UART*.
Input Parameter 1	*UARTx*: Selects the UART to be configured. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	*StopBits*: Selects the number of the stop bits. Refer to *UART stop bits on page 142* for details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to configure the *UART0* stop bits number to 1 stop bit:

```
{
  /*Configure the UART0 stop bits to 1 stop bit */
  UART_StopBitsConfig(UART0, UART_1_StopBits);
  ...
}
```

UART_Config

Function Name	UART_Config

Function Prototype	`void UART_Config( UART_TypeDef *UARTx,`
	`u32 BaudRate,`
	`UARTParity_TypeDef Parity,`
	`UARTStopBits_TypeDef StopBits,`
	`UARTMode_TypeDef Mode );`

Behavior Description	This function configures the Baud rate, parity mode, the number of stop bits and the UART mode of the selected UART.
Input Parameter 1	*UARTx*: the selected UART. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	*BaudRate*: the baudrate value in bps.
Input Parameter 3	*Parity*: selects the parity type. Refer to *UART parity modes on page 143* for details on the allowed values of this parameter.
Input Parameter 4	*StopBits*: selects the number of the stop bits. Refer to *UART stop bits on page 142* for details on the allowed values of this parameter.
Input Parameter 5	*Mode*: selects the UART mode. Refer to *UART modes on page 143* for details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	*UART_ModeConfig on page 147*, *UART_BaudRateConfig on page 147*, *UART_ParityConfig on page 148*, *UART_StopBitsConfig on page 148*.

Example:

This example illustrates how to configure the *UART0*:

```
{
/* Configure the UART0 as following:
                  - Baudrate = 9600 Bps
                  - No parity
                  - 8 data bits
                  - 1 stop bit */
  UART_Config(UART0, 9600, UART_NO_PARITY, UART_1_StopBits,
UARTM_8D);
  ...
}
```

UART_ItConfig

Function Name	UART_ItConfig
Function Prototype	`void UART_ItConfig(UART_TypeDef *UARTx, u16 UART_Flag, FunctionalState NewState);`
Behavior Description	This function enables or disables one or several interrupt sources of the selected UART.
Input Parameter 1	UARTx: the selected UART. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	*UART_Flag:* selects one or several UART interrupt sources. Refer to *Interrupt and status flags on page 144* for details on the allowed values of this parameter.
Input Parameter 3	*NewStatus*: specifies whether the *interrupt source* is enabled or disabled. – *ENABLE*: enables the *IRQ* interrupt – *DISABLE*: disables the *IRQ* interrupt.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Note: All the UART flags are listed in the 71x_uart.h file can be selected as interrupt source except the UART_TxFull flag which is not affected by this function.

Example:

This example illustrates how to enable and disable the Receiver Buffer Full Interrupt sources in the UART:

```
{
  /*Enable Receiver Buffer Full interrupt */
  UART_ItConfig(UART0, UART_RxBufFull, ENABLE);
  ...
  /*Disable Receiver Buffer Full interrupt */
  UART_ItConfig(UART0, UART_RxBufFull, DISABLE);
  ...
}
```

UART_FifoConfig

Function Name	UART_FifoConfig
Function Prototype	`void UART_FifoConfig(UART_TypeDef *UARTx, FunctionalState NewState);`
Behavior Description	This routine Enables or Disables the Rx and Tx FIFOs of the selected *UART*.
Input Parameter 1	*UARTx*: the selected UART. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	*NewStatus*: specifies whether the *FIFOs* are enabled or disabled. – *ENABLE*: enables FIFOs – *DISABLE*: disables FIFOs.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to enable the *UART0* FIFOs:

```
{
  /*Enable the UART 0 FIFOs */
  UART_FifoConfig(UART0, ENABLE);
  ...
}
```

UART_FifoReset

Function Name	UART_FifoReset
Function Prototype	`void UART_FifoReset(UART_TypeDef *UARTx, UARTFIFO_TypeDef FIFO);`
Behavior Description	This function resets the Rx and the Tx FIFOs of the selected UART..
Input Parameter 1	*UARTx*: Selects the *UART* to be configured. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	*FIFO*: Selects the FIFO to reset. Refer to *FIFOs on page 142* for details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to reset the *UART0* receive FIFO:

```
{
  /*Reset the UART0 receive FIFO */
  UART_FifoReset(UART0, UART_RxFIFO);
  ...
}
```

UART_LoopBackConfig

Function Name	UART_LoopBackConfig
Function Prototype	`void UART_LoopBackConfig(UART_TypeDef *UARTx, FunctionalState NewState);`
Behavior Description	This function enables or disables the loop back mode of the selected UART.
Input Parameter 1	*UARTx*: Selects the *UART* to be configured. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	*NewState*: specifies whether loop back is enabled or disabled. – *ENABLE*: enables Loop back – *DISABLE*: disables Loop back.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to loop back in the *UART0*:

```
{
  /* Enable loop back on the UART 0 */
  UART_LoopBackConfig(UART0, ENABLE);
  ...
}
```

UART_TimeOutPeriodConfig

Function Name	UART_TimeOutPeriodConfig
Function Prototype	`void UART_TimeOutPeriodConfig(UART_TypeDef *UARTx, u16 TimeOutPeriod);`
Behavior Description	This routine configures the time-out period of the selected *UART*.
Input Parameter 1	*UARTx*: the selected UART. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	*TimeOutPeriod*: the time-out period value.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to configure the *UART0* time out period:

```
{
  /*Configure the UART0 time-out period */
  UART_TimeOutPeriodConfig(UART0, 0xFF);
  ...
}
```

UART_GuardTimeConfig

Function Name	UART_GuardTimeConfig
Function Prototype	`void UART_GuardTimeConfig(UART_TypeDef *UARTx, u16 GuardTime);`
Behavior Description	This routine configures the guard time of the selected *UART*.
Input Parameter 1	*UARTx*: Selects the *UART* to be configured. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	*GuardTime*: the guard time value
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to configure the *UART0* guard time:

```
{
  /* Configure the guard time */
  UART_GuardTimeConfig(UART0, 0xFF);
  ...
}
```

UART_RxConfig

Function Name	UART_RxConfig
Function Prototype	`void UART_RxConfig(UART_TypeDef *UARTx, FunctionalState NewState);`
Behavior Description	This function enables or disables the selected UART data reception.
Input Parameter 1	*UARTx*: Selects the *UART* to be configured. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	*NewState*: specifies whether the reception is enabled or disabled. – *ENABLE*: enables reception – *DISABLE*: disables reception.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to enable reception on the *UART0*:

```
{
  /* Enable reception */
  UART_RxConfig(UART0, ENABLE);
  ...
}
```

UART_OnOffConfig

Function Name	UART_OnOffConfig
Function Prototype	`void UART_OnOffConfig(UART_TypeDef *UARTx, FunctionalState NewState);`
Behavior Description	This routine turns On / Off the selected UART.
Input Parameter 1	*UARTx*: Selects the *UART* to be configured. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	*NewState*: specifies whether the *UART* is enabled or disabled. – *ENABLE*: enables the UART – *DISABLE*: disables the UART.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to turn the UART0 On:

```
{
  /*Turn the UART On */
  UART_OnOffConfig(UART0, ENABLE);
  ...
}
```

UART_ByteSend

Function Name	UART_ByteSend
Function Prototype	`void UART_ByteSend(UART_TypeDef *UARTx, u8 *Data);`
Behavior Description	This function sends a 7-bit byte or an 8-bit byte using the selected *UART*.
Input Parameter 1	*UARTx*: Selects the UART to be configured. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	*Data*: a pointer on the data byte to send.
Output Parameter	None
Return Value	None
Required preconditions	The selected *UART* must be properly configured and enabled. See *UART_Config* and *UART_OnOffConfig* functions.
Called Functions	None

Example:

This example illustrates how to send an 8-bit byte using the *UART0*:

```
{
  u8 Data = 0x55;
  UART_ByteSend(UART0, &Data);
}
```

UART_9BitByteSend

Function Name	UART_9BitByteSend
Function Prototype	`void UART_9BitByteSend(UART_TypeDef *UARTx, u16 *Data);`
Behavior Description	This function sends a 9-bit data using the selected *UART*.
Input Parameter 1	*UARTx*: the selected UART. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	*Data*: a pointer on the 9-bit data to send.
Output Parameter	None
Return Value	None
Required preconditions	The selected *UART* must be properly configured and enabled.
Called Functions	None
See also	*UART_Config on page 149*, *UART_OnOffConfig on page 154*

Example:

This example illustrates how to send a 9-bit byte using the *UART0*:

```
{
  u16 Data = 0x0155;
  UART_9BitByteSend(UART0, &Data);
}
```

UART_DataSend

Function Name	UART_DataSend
Function Prototype	`void UART_DataSend(UART_TypeDef *UARTx, u8 *Data, u8 DataLength);`
Behavior Description	This routine sends several 7-bit bytes or 8-bit bytes using the selected *UART*.
Input Parameter 1	*UARTx*: the selected UART. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	*Data*: The bytes start address.
Input Parameter 3	*DataLength*: The data bytes number.
Output Parameter	None
Return Value	None
Required preconditions	The selected *UART* must be properly configured and enabled.
Called Functions	None
See also	*UART_Config on page 149*, *UART_OnOffConfig on page 154*

Example:

This example illustrates how to send several 8-bit bytes using the *UART0*:

```
{
  #define DATA_LENGTH 16
  u8 pDataToSend[DATA_LENGTH] = {'A', 'B', 'C', 'D', 'E', 'F',
'G', 'H',
                                 'I', 'J', 'K', 'L', 'M', 'N',
'O', 'P'};
  UART_DataSend(UART0, pDataToSend, DATA_LENGTH);
  ...
}
```

UART_9BitDataSend

Function Name	UART_9BitDataSend
Function Prototype	`void UART_9BitDataSend(UART_TypeDef *UARTx, u16 *Data, u8 DataLength);`
Behavior Description	This function sends several 9-bit data using the selected *UART*.
Input Parameter 1	*UARTx*: the selected UART. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	*Data*: the bytes start address.
Input Parameter 3	*DataLength*: the data bytes number.
Output Parameter	None
Return Value	None
Required preconditions	The selected *UART* must be properly configured and enabled.
Called Functions	None
See also	*UART_Config on page 149*, *UART_OnOffConfig on page 154*

Example:

This example illustrates how to send several 9-bit bytes using the *UART0*:

```
{
  #define DATA_LENGTH 16
  u16 pwDataToSend[DATA_LENGTH]= {0x0101, 0x0002, 0x0103,
0x0004,
                                  0x0105, 0x0006, 0x0107, 0x0008,
                                  0x0109, 0x000A, 0x010B, 0x000C,
                                  0x010D, 0x000E, 0x010F, 0x000F};
  UART_9BitDataSend(UART0, pwDataToSend, DATA_LENGTH);
  ...
}
```

UART_StringSend

Function Name	UART_StringSend
Function Prototype	`void UART_StringSend(UART_TypeDef *UARTx, u8 *String);`
Behavior Description	This routine sends a 7-bit byte or 8-bit string using the selected *UART*.
Input Parameter 1	*UARTx*: Selects the *UART* to be configured. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	*String*: The string start address.
Output Parameter	None
Return Value	None
Required preconditions	The selected *UART* must be properly configured and enabled.
Called Functions	UART_ByteSend
See also	*UART_Config on page 149*, *UART_OnOffConfig on page 154*

Example:

This example illustrates how to send a string using the *UART0*:

```
{
  /* Send "Hello World" */
  UART_StringSend(UART0, (u8 *)&"Hello World");
  ...
}
```

UART_ByteReceive

Function Name	UART_ByteReceive
Function Prototype	`u16 UART_ByteReceive(UART_TypeDef *UARTx, u8 *Data, u8 TimeOut);`
Behavior Description	This routine gets a 7 or an 8-bit byte from the selected *UART*.
Input Parameter 1	*UARTx*: the selected UART. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	Data: a pointer on the data where the data will be stored
Input Parameter 3	*TimeOut*: The Time-out value.
Output Parameter	The received 8-bit data.
Return Value	The UARTx_SR register content before reading the received data.
Required preconditions	The selected *UART* must be properly configured and enabled.
Called Functions	None.
See also	*UART_Config on page 149*, *UART_OnOffConfig on page 154*

Example:

This example illustrates how to read the received data on the UART0:

```
{
  u8 bRxData;
  u16 wUART_Status;
  ...
  /*Read the received data */
  wUART_Status = UART_ByteReceive(UART0, &bRxData, 0xFF);
  /* Check if data received without error */
  if (wUART_Status & ( UART_ParityError  |
                       UART_FrameError   |
                       UART_OverrunError |
                       UART_TimeOutIdle  ))
  {
    /* handles the error */
    ...
  }
  ...
  while(!(UART_FlagStatus(UART0) & UART_RxBufFull)); /* while
the receive
                                                        buffer is
empty */
  wUART_Status = UART_ByteReceive(UART0, &bRxData, 0xFF);
  ...
}
```

UART_9BitByteReceive

Function Name	UART_9BitByteReceive
Function Prototype	`u16 UART_9BitByteReceive(UART_TypeDef *UARTx, u16 *Data, u8 TimeOut);`
Behavior Description	This routine gets a 9-bit byte from the selected *UART*.
Input Parameter 1	*UARTx*: the selected UART. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	*Data*: A pointer to the received data.
Input Parameter 3	*TimeOut*: The Time-out value.
Output Parameter	The received 9-bit data.
Return Value	he UARTx_SR register contents before reading the received data.
Required preconditions	The selected *UART* must be properly configured and enabled.
Called Functions	None.
See also	*UART_Config on page 149*, *UART_OnOffConfig on page 154*

Example:

This example illustrates how to read the received data on the *UART0*:

```
{
  u16 wRxData;
  u16 wUART_Status;
  ...
  /*Read the received data */
  wUART_Status=UART_9BitByteReceive(UART0, &wRxData, 0xFF);
  /* Check if data received without error */
  if (wUART_Status & ( UART_ParityError  |
                       UART_FrameError   |
                       UART_OverrunError |
                       UART_TimeOutIdle  ))
  {
    /* handles the error */
    ...
  }
  ...
  while(!(UART_FlagStatus(UART0) & UART_RxBufFull)); /* while
the receive
                                                      buffer is
empty */
  wUART_Status = UART_9BitByteReceive(UART0, &bRxData, 0xFF);
  ...
}
```

UART_DataReceive

Function Name	UART_DataReceive
Function Prototype	`u16 UART_DataReceive(UART_TypeDef *UARTx, u8 *Data, u8 DataLength, u8 TimeOut);`
Behavior Description	Gets several 7 or 8-bit bytes from the selected *UART*.
Input Parameter 1	*UARTx*: the selected UART. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	*Data*: A pointer to the received data.
Input Parameter 3	*DataLength*: The number of bytes to receive.
Input Parameter 4	*TimeOut*: The Time-out value.
Output Parameter	The received 8-bit data buffer
Return Value	The UARTx_SR register content before reading the received data.
Required preconditions	The selected *UART* must be properly configured and enabled.
Called Functions	*UART_ByteReceive*
See also	*UART_Config on page 149*, *UART_OnOffConfig on page 154*

Example:

This example illustrates how to read several data from the *UART0*:

```
{
  #define DataLength 16
  u8 bRxData[DataLength];
  u16 wUART_Status;
  ...
  //Read the received data
  u16 UART_DataReceive(UART0, bRxData, DataLength, 0xff);
  /* Check if data received without error */
  if (wUART_Status & ( UART_ParityError  |
                       UART_FrameError   |
                       UART_OverrunError |
                       UART_TimeOutIdle  ))
  {
    /* handles the error */
    ...
  }
}
```

UART_9BitDataReceive

Function Name	UART_9BitDataReceive
Function Prototype	`u16 UART_9BitDataReceive(UART_TypeDef *UARTx, u16 *Data, u8 DataLength, u8 TimeOut);`
Behavior Description	This routine gets several 9-bit bytes from the selected *UART*.
Input Parameter 1	*UARTx*: Selects the *UART* to be configured. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter 2	Data: a pointer on the buffer where the data will be stored.
Input Parameter 3	*DataLength*: the number of bytes to receive.
Input Parameter 4	*TimeOut*: the time-out period value.
Output Parameter	The received 9-bit data buffer.
Return Value	The status register value before reading the received data.
Required preconditions	The selected *UART* must be properly configured and enabled.
Called Functions	*UART_9BitByteReceive*
See also	*UART_Config on page 149*, *UART_OnOffConfig on page 154*

Example:

This example illustrates how to read several 9-bit bytes from the *UART0*:

```
{
  #define DataLength 16
  u16 wRxData[DataLength];
  u16 wUART_Status;
  ...
  //Read the received data
  u16 UART_9BitDataReceive(UART0, wRxData, DataLength, 0xff);
  /*Check if data received without error */
  if (wUART_Status & ( UART_ParityError  |
                       UART_FrameError   |
                       UART_OverrunError |
                       UART_TimeOutIdle  ))
  {
    /* handles the error */
    ...
  }
}
```

UART_StringReceive

Function Name	UART_StringReceive
Function Prototype	`u16 UART_StringReceive(UART_TypeDef *UARTx, u8 *Data);`
Behavior Description	This function gets a string which ends with: End of string or Carriage return characters from the selected UART.
Input Parameter1	*UARTx*: Selects the *UART* to be configured. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Input Parameter2	*Data*: a pointer on the buffer where the data will be stored.
Output Parameter	The received string.
Return Value	The UARTx_SR register contents before reading the received data.
Required preconditions	The selected UART must be properly configured and enabled.
Called Functions	None.
See also	*UART_Config on page 149*, *UART_OnOffConfig on page 154*

Example:

This example illustrates how to get a string from the *UART0*:

```
{
  u8 bRxData[10];
  u16 wUART_Status;
  ...
  /* Read the received data */
  UART_StringReceive(UART0, &bRxData);
  /* Check if data received without error */
  if (wUART_Status & ( UART_ParityError  |
                       UART_FrameError   |
                       UART_OverrunError |
                       UART_TimeOutIdle  ))
  {
    /* handles error */
    ...
  }
}
```

UART_FlagStatus

Function Name	UART_FlagStatus
Function Prototype	`u16 UART_FlagStatus(UART_TypeDef *UARTx);`
Behavior Description	This routine returns the UARTx_SR register content of the selected UART.
Input Parameter	*UARTx*: the selected UART. *x* can be 0, 1, 2 or 3. Refer to *UARTx values on page 145* for details on the allowed values of this parameter.
Output Parameter	None
Return Value	The status register content of the selected *UART*.
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to get the status of the *UART0*:

```
{
  u16 wUART_Status;
  wUART_Status = UART_FlagStatus(UART0);
}
```

SendChar

Function Name	SendChar
Function Prototype	`void SendChar(u8 *ch)`
Behavior Description	This function sends a character to the defined UART.
Input Parameter	ch: a pointer to the character to send.
Output Parameter	None
Return Value	None.
Required preconditions	Define USE_SERIAL_PORT in 71x_conf.h file: `#define USE_SERIAL_PORT` Then define the UART to be used: ex: #define USE_UART0
Called Functions	UART_ByteSend

Example:

This example illustrates how to send a char with the SendChar function:

in 71x_conf.h file define:

```
#define USE_SERIAL_PORT
#define USE_UART0

{
 char c;
c='A';
  wUART_Status = SendChar((u8 *)c);
}
```

3.12 Inter-integrated circuit (I^2C)

The I^2C Bus interface module serves as interface between the microcontroller and the serial I^2C bus. It provides both multi-master and slave functions, and controls all I^2C bus-specific sequencing, protocol, arbitration and timing.

The I^2C driver may be used to manage the I^2C functionality in transmission and reception and it report the status of the action done.

The first section describes the data structures used in the I^2C firmware library. The second one presents the firmware library functions.

3.12.1 Data structures

I^2C register structure

The I^2C registers structure *I2C_TypeDef* is defined in the *71x_map.h* file as follows:

```
typedef volatile struct
{
  vu8  CR;
  vu8  EMPTY1[3];
  vu8  SR1;
  vu8  EMPTY2[3];
  vu8  SR2;
  vu8  EMPTY3[3];
  vu8  CCR;
  vu8  EMPTY4[3];
  vu8  OAR1;
  vu8  EMPTY5[3];
  vu8  OAR2;
  vu8  EMPTY6[3];
  vu8  DR;
  vu8 EMPTY7[3];
  vu8 ECCR;
  vu8 EMPTY8[3];
} I2C_TypeDef;
```

Table 71 presents the *I^2C* registers.

Table 71. I^2C registers

Register	Description
CR	I^2C Control Register
SR1	I^2C Status Register1
SR2	I^2C Status Register2
CCR	I^2C Clock Control Register
ECCR	I^2C Extended Clock Control Register
OAR1	I^2C Own Address Register1
OAR2	I^2C Own Address Register2
DR	I^2C Data Register

The two *I²C* interfaces are declared in the same file:

```
...
#define APB1_BASE       0xC0000000
....
#define I2C0_BASE       (APB1_BASE + 0x1000)
#define I2C1_BASE       (APB1_BASE + 0x2000)
#ifndef DEBUG
  ...
#ifdef _I2C0
  #define I2C0          ((I2C_TypeDef *)I2C0_BASE)
#endif /*I2C0*/

#ifdef _I2C1
  #define I2C1          ((I2C_TypeDef *)I2C1_BASE)
#endif /*I2C1*/
...
#else  /* DEBUG */
  ...
#ifdef _I2C0
    EXT I2C_TypeDef     *I2C0;
#endif /*I2C0*/

#ifdef _I2C1
    EXT I2C_TypeDef     *I2C1;
#endif /*I2C1*/
...
#endif
```

When debug mode is used, *I²C* pointer is initialized in *71x_lib.c* file:

```
#ifdef _I2C0
   I2C0  = (I2C_TypeDef  *)I2C0_BASE;
 #endif  /* _I2C0 */
 #ifdef _I2C1
   I2C1  = (I2C_TypeDef  *)I2C1_BASE;
 #endif /* _I2C1 */
```

_I2C0 and *_I2C1* must be defined, in *71x_conf.h* file, to access the peripheral registers as follows:

```
#define _I2C
#define _I2C0
#define _I2C1
...
```

When RCCU functions are called, *_RCCU* must be defined, in *71x_conf.h* file, to make the *RCCU* functions accessible:

```
#define _RCCU
```

I²C registers

The following enumeration defines the registers of the *I²C* and their offset. *I2C_Registers* enumeration is defined in the file *71x_i2c.h* as follows:

```
typedef enum
{
  I2C_CR     =  0x00,
```

```
  I2C_SR1     =  0x04,
  I2C_SR2     =  0x08,
  I2C_CCR     =  0x0C,
  I2C_OAR1    =  0x10,
  I2C_OAR2    =  0x14,
  I2C_DR      =  0x18,
  I2C_ECCR    =  0x1C
} I2C_Registers;
```

I²C addressing modes

The following enumeration defines the *I²C* addressing mode. The *I2C_Addressing* enumeration is defined in the file *71x_i2c.h* as follows:

```
typedef enum
{
  I2C_Mode10,
  I2C_Mode7
} I2C_Addressing;
```

Table 72 defines the *I²C* addressing modes.

Table 72. I²C addressing modes

Addressing mode	Description
I2C_Mode10	10-bit addressing mode
I2C_Mode7	7-bit addressing mode

I²C transfer direction

The following enumeration defines the *I²C* transfer direction. The *I2C_Direction* enumeration is defined in the file 71x_i2c.h as follows:

```
typedef enum
{
  I2C_RX,
  I2C_TX
} I2C_Direction;
```

Table 73 defines the *I²C* transfer direction.

Table 73. I²C transfer direction

I²C direction	Description
I2C_TX	Transmission
I2C_RX	Reception

I²C flags

The following definitions defines the *I²C* flags. *I2C flags* are defined in the file *71x_i2c.h*:

```
#define I2C_SB              0x00001
#define I2C_M_SL            0x00002
```

```
#define I2C_ADSL            0x00004
#define I2C_BTF             0x00008
#define I2C_BUSY            0x00010
#define I2C_TRA             0x00020
#define I2C_ADD10           0x00040
#define I2C_EVF             0x00080
#define I2C_GCAL            0x00100
#define I2C_BERR            0x00200
#define I2C_ARLO            0x00400
#define I2C_STOPF           0x00800
#define I2C_AF              0x01000
#define I2C_ENDAD           0x02000
#define I2C_STOP            0x08000
#define I2C_ACK             0x10000
#define I2C_START           0x20000

#define I2C_PESET_Mask      0x20
#define I2C_PERESET         0xDF
#define I2C_ENGC_Mask       0x10
#define I2C_START_Mask      0x08
#define I2C_STOP_Mask       0x02
#define I2C_ACK_Mask        0x04
#define I2C_ITE_Mask        0x01
#define I2C_Event_Mask      0x3FFF
```

Table 74 describes I²C flags.

Table 74. I²C flags

Flag	Flag Code
I2C_SB: Start (Master mode) flag	0x00001
I2C_M_SL: Master/Slave flag.	0x00002
I2C_ADSL: Address matched (Slave mode) flag.	0x00004
I2C_BTF: Byte transfer finished flag.	0x00008
I2C_BUSY: Bus busy flag.	0x00010
I2C_TRA: Transmitter/Receiver flag.	0x00020
I2C_ADD10: 10-Bit addressing in master mode	0x00040
I2C_EVF: Event flag	0x00080
I2C_GCAL: General call (slave mode) flag	0x00100
I2C_BERR: Bus error flag	0x00200
I2C_ARLO: Arbitration lost flag	0x00400
I2C_STOPF: Stop detection (slave mode)	0x00800
I2C_AF: Acknowledge failure flag	0x01000
I2C_ENDAD: End of address transmission	0x02000
I2C_STOP: Generation of a Stop condition	0x08000
I2C_ACK: Acknowledge enable.	0x10000
I2C_START: Generation of a Start condition	0x20000

I²C events

```
#define  I2C_EVENT_SLAVE_ADDRESS_MATCHED
#define  I2C_EVENT_SLAVE_BYTE_RECEIVED
#define  I2C_EVENT_SLAVE_BYTE_TRANSMITTED
#define  I2C_EVENT_MASTER_MODE_SELECT
#define  I2C_EVENT_MASTER_MODE_SELECTED
#define  I2C_EVENT_MASTER_BYTE_RECEIVED
#define  I2C_EVENT_MASTER_BYTE_TRANSMITTED
#define  I2C_EVENT_MASTER_MODE_ADDRESS10
#define  I2C_EVENT_SLAVE_STOP_DETECTED
#define  I2C_EVENT_SLAVE_ACK_FAILURE
#define  I2C_BUS_ERROR_DETECTED
#define  I2C_ARBITRATION_LOST
#define  I2C_SLAVE_GENERAL_CALL
```

I²C transmission status

The following enumeration defines the different types of message returned to define the status of transmission. The *I2C_Tx_Status* enumeration is declared in the file *71x_i2c.h*

```
typedef enum {
                I2C_TX_NO,
                I2C_TX_SB,
                I2C_TX_AF,
                I2C_TX_ARLO,
                I2C_TX_BERR,
                I2C_TX_ADD_OK,
                I2C_TX_DATA_OK,
                I2C_TX_ONGOING
              } I2C_Tx_Status;
```

Table 75 describes I²C transmission status messages.

Table 75. I²C transmission status messages

I2C_Tx_Status	Description
I2C_TX_NO	No start condition is generated or detected so no transmission is occurring
I2C_TX_SB	START condition is generated
I2C_TX_AF	Acknowledge Failure is detected
I2C_TX_ARLO	Arbitration Lost error is detected in multimaster mode
I2C_TX_BERR	Bus Error is detected
I2C_TX_ADD_OK	Slave address transmission is correctly completed in master mode or address matched in slave mode
I2C_TX_DATA_OK	Last transmitted data is correctly completed
I2C_TX_ONGOING	The current transmission is occurring

I²C reception status

The following enumeration defines the different types of message returned to define the status of the reception. The *I2C_Rx_Status* enumeration is declared in the file *71x_i2c.h*

```
typedef enum {
                I2C_RX_NO,
                I2C_RX_SB,
                I2C_RX_AF,
                I2C_RX_ARLO,
                I2C_RX_BERR,
                I2C_RX_ADD_OK,
                I2C_RX_DATA_OK,
                I2C_RX_ONGOING
              } I2C_Rx_Status;
```

Table 76 describes I²C reception status messages.

Table 76. I²C reception status messages

I2C_Rx_Status	Description
I2C_Rx_NO	No start condition is generated or detected so no reception is occurring
I2C_Rx_SB	START condition is generated
I2C_Rx_AF	Acknowledge Failure is detected
I2C_Rx_ARLO	Arbitration Lost error is detected in multimaster mode
I2C_Rx_BERR	Bus Error is detected
I2C_Rx_ADD_OK	Slave address transmission is correctly completed
I2C_Rx_DATA_OK	Last Received data is correctly completed
I2C_Rx_ONGOING	The current reception is occurring

3.12.2 Firmware library functions

Table 77 enumerates the different functions of the *I²C* library.

Table 77. I²C library functions

Function Name	Description
I2C_Init	Initializes *I²C* peripheral control and registers to their default reset values.
I2C_OnOffConfig	Enables or disables *I²C* peripheral.
I2C_GeneralCallConfig	Enables or disables *I²C* general call option.
I2C_STARTGenerate	Generates *I²C* communication START condition.
I2C_STOPGenerate	Generates *I²C* communication STOP condition.
I2C_AcknowledgeConfig	Enables or disables *I²C* acknowledge feature.
I2C_ITConfig	Enables or disables *I²C* interrupt feature.
I2C_RegisterRead	Reads any *I²C* register and returns its value.
I2C_FlagStatus	Checks whether any *I²C* Flag is set or not.
I2C_FlagClear	Clears any *I²C* Flag.

Table 77. I²C library functions (continued)

Function Name	Description
I2C_SpeedConfig	Selects *I²C* clock speed and configures its corresponding mode.
I2C_AddressConfig	Defines the *I²C* bus address of the interface.
I2C_FCLKConfig	Configures frequency bits according to *RCLK* frequency.
I2C_AddressSend	Transmits the address byte to select the slave device.
I2C_ByteSend	Transmits single byte of data.
I2C_TransmissionStatus	Checks for any error during transmission and returns the error status. It also checks for any pending requests.
I2C_ByteReceive	Returns the most recently received byte.
I2C_ReceptionStatus	Checks the completion of reception and returns the reception status.
I2C_ErrorClear	Clears any error flags.
I2C_GetStatus	Reads the status registers of the specified I2C
I2C_GetLastEvent	Gets the last I2C event that has occurred.
I2C_CheckEvent	Checks whether the last I2C event is equal to the one passed as parameter.

I2C_Init

Function Name	I2C_Init
Function Prototype	`void I2C_Init (I2C_TypeDef *I2Cx);`
Behavior Description	Initializes *I²C* peripheral control and registers to their default reset values.
Input Parameter	*I2Cx*: specifies the I2C to be initialized where x can be 0 or 1.
Output Parameters	None
Return Value	None
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to initialize the *I2C0* register to their reset value:

```
{
  ...
  I2C_Init (I2C0);
  ...
}
```

I2C_OnOffConfig

Function Name	I2C_OnOffConfig
Function Prototype	`void I2C_OnOffConfig (I2C_TypeDef *I2Cx, FunctionalState NewState);`
Behavior Description	Enables or disables the I2C peripheral.
Input Parameter 1	*I2Cx*: specifies the I2C to be enabled or disabled where x can be 0 or 1.
Input Parameter 2	*NewState*: specifies the new status to set – *ENABLE*: enables the I^2C peripheral. – *DISABLE*: disables the I^2C peripheral
Output Parameter	None
Return Value	None
Required Preconditions	I/O ports should be configured in their reset states.
Called Functions	None

Example:

This example illustrates how to enable and disable the *I2C0* interface:

```
{
  ...
  I2C_OnOffConfig (I2C0, ENABLE);
  ...
  /*user code */
  ...
  I2C_OnOffConfig (I2C0, DISABLE);
  ...
}
```

I2C_GeneralCallConfig

Function Name	I2C_GeneralCallConfig
Function Prototype	`void I2C_GeneralCallConfig (I2C_TypeDef *I2Cx, FunctionalState NewState);`
Behavior Description	Enables or disables I2C general call option.
Input Parameter 1	*I2Cx*: specifies the I2C to be configured where *x* can be 0 or 1.
Input Parameter 2	*NewState*: specifies the new status to set – *ENABLE*: enables the I^2C general call option – *DISABLE*: disables the I^2C general call option
Output Parameter	None
Return Value	None
Required Preconditions	*I^2Cx* peripheral should be enabled.
Called Functions	None

Example:

This example illustrates how to enable the General Call option:

```
{
  ...
  I2C_OnOffConfig (I2C0, ENABLE);
  ...
  I2C_GeneralCallConfig (I2C0, ENABLE);
  ...
}
```

I2C_STARTGenerate

Function Name	I2C_STARTGenerate
Function Prototype	`void I2C_STARTGenerate (I2C_TypeDef *I2Cx, FunctionalState NewState);`
Behavior Description	Enables or disables *I²C* start generation.
Input Parameter 1	*I2Cx*: specifies the I2C to be configured where *x* can be 0 or 1.
Input Parameter 2	*NewState*: specifies the new status to set – *ENABLE*: enables the *I²C* start generation – *DISABLE*: disables the *I²C* start generation
Output Parameter	None
Return Value	None
Required Preconditions	*I²C*x peripheral should be enabled.
Called Functions	None

Example:

This example illustrates how to enable the start generation in the *I2C0* peripheral:

```
{
  ...
  I2C_OnOffConfig (I2C0, ENABLE);
  ...
  I2C_STARTGenerate (I2C0, ENABLE);
  ...
}
```

I2C_STOPGenerate

Function Name	I2C_STOPGenerate
Function Prototype	`void I2C_STOPGenerate (I2C_TypeDef *I2Cx, FunctionalState NewState);`
Behavior Description	Enables or disables *I²C* stop generation.
Input Parameter 1	*I2Cx*: specifies the I2C to be configured where *x* can be 0 or 1.
Input Parameter 2	*NewState*: specifies the new status to set: – *ENABLE*: enables the *I²C* stop generation – *DISABLE*: disables the *I²C* stop generation
Output Parameter	None
Return Value	None
Required Preconditions	*I²Cx* peripheral should be enabled.
Called Functions	None

Example:

This example illustrates how to enable the *STOP* Generation in the *I2C0* peripheral:

```
{
  ...
  I2C_OnOffConfig (I2C0, ENABLE);
  ...
  I2C_STOPGenerate (I2C0, ENABLE);
  ...
}
```

I2C_AcknowledgeConfig

Function Name	I2C_AcknowledgeConfig
Function Prototype	`void I2C_AcknowledgeConfig (I2C_TypeDef *I2Cx, FunctionalState NewState);`
Behavior Description	Enables or disables *I²C* acknowledge feature.
Input Parameter 1	*I2Cx*: specifies the I2C to be configured where *x* can be 0 or 1.
Input Parameter 2	*NewState*: specifies the new status to set: – *ENABLE*: enables the *I²C* acknowledge feature – *DISABLE*: disables the *I²C* acknowledge feature
Output Parameter	None
Return Value	None
Required Preconditions	*I²Cx* peripheral should be enabled.
Called Functions	None

Example:

This example illustrates how to enable the acknowledge feature in the *I2C0* peripheral:

```
{
  ...
  I2C_OnOffConfig (I2C0, ENABLE);
  ...
  I2C_AcknowledgeConfig (I2C0, ENABLE);
  ...
}
```

I2C_ITConfig

Function Name	I2C_ITConfig
Function Prototype	`void I2C_ITConfig (I2C_TypeDef *I2Cx, FunctionalState NewState);`
Behavior Description	Enables or disables *I²C* interrupt feature.
Input Parameter 1	*I2Cx*: specifies the I2C to be configured where *x* can be 0 or 1.
Input Parameter 2	*NewState*: specifies the new status to set: – *ENABLE*: enables the *I²C* interrupt feature – *DISABLE*: disables the *I²C* interrupt feature
Output Parameter	None
Return Value	None
Required Preconditions	*I²Cx* peripheral should be enabled.
Called Functions	None

Example:

This example illustrates how to enable the interrupt feature in the *I2C0* peripheral:

```
{
  ...
  I2C_OnOffConfig (I2C0, ENABLE);
  ...
  I2C_ITConfig (I2C0, ENABLE);
  ...
}
```

I2C_RegisterRead

Function Name	I2C_RegisterRead
Function Prototype	`u8 I2C_RegisterRead (I2C_TypeDef *I2Cx, I2C_Registers reg);`
Behavior Description	Reads any I2C register and returns its value.
Input Parameter 1	*I2Cx*: specifies the I2C to read its register where *x* can be 0 or 1.
Input Parameter 2	*reg*: specifies the register to read. For more details on the allowed values of this parameter, refer to *I2C registers on page 166*.
Output Parameter	None
Return Value	The value of the register passed as parameter
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to get a register value:

```
{
  vu8 Register_Value;
  ...
  Register_Value = I2C_RegisterRead (I2C0, I2C_CCR);
  ...
}
```

I2C_FlagStatus

Function Name	I2C_FlagStatus
Function Prototype	`FlagStatus I2C_FlagStatus (I2C_TypeDef *I2Cx, u32 Flag);`
Behavior Description	Checks whether the *I²C* flag is set or not.
Input Parameter 1	*I2Cx*: specifies the I2C to read its flags where *x* can be 0 or 1.
Input Parameter 2	*Flag*: specifies the flag to check. Refer to *I2C flags on page 167* for more details on allowed values of *Flag* parameter.
Output Parameter	None
Return Value	The specified flag status: – *SET*: if the tested flag is set. – *RESET*: if the tested flag is reset.
Required Preconditions	None
Called Functions	None.

Example:

This example illustrates how to get flag status:

```
{
u32 I2CStatus;

  do
  {
    I2C_STARTGenerate( I2C0, ENABLE );
    while( I2C_FlagStatus( I2C0, I2C_SB) == RESET );
    I2C_AddressSend( I2C0, M24C08_Block3ADDRESS, I2C_Mode7,
I2C_TX );
    while(!((I2CStatus = I2C_GetStatus( I2C0 ))& I2C_EVF))
    while( I2C_FlagStatus( I2C0, I2C_ENDAD ) ==RESET );
    I2C_FlagClear( I2C0, I2C_ENDAD );

  }while( I2C_FlagStatus( I2C0, I2C_AF, I2CStatus ) == SET );
}
```

I2C_FlagClear

Function Name	I2C_FlagClear
Function Prototype	`void I2C_FlagClear (I2C_TypeDef *I2Cx, u32 Flag, ...);`
Behavior Description	Clears the I2C Flag passed as a parameter.
Input Parameter 1	*I2Cx*: specifies the I2C to clear its flags where *x* can be 0 or 1.
Input Parameter 2	*Flag*: the flag to be read. Refer to *I2C flags on page 167* for more details on allowed values of *Flag* parameter.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	I2C_OnOffConfig

Example:

This example illustrates how to clear the *I2C_STOPF* flag:

```
{
  ...
  I2C_FlagClear (I2C0, I2C_STOPF)
  ...
}
```

I2C_SpeedConfig

Function Name	I2C_SpeedConfig
Function Prototype	`void I2C_SpeedConfig (I2C_TypeDef *I2Cx, u32 Clock);`
Behavior Description	Configures the I^2C clock speed.
Input Parameter 1	*I2Cx*: specifies the I2C to be configured where *x* can be 0 or 1.
Input Parameter 2	*Clock*: the I^2C expected clock in Hertz.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	*RCCU_FrequencyValue on page 43*

Example:

This example illustrates how to configure the clock speed:

```
{
  ...
  I2C_SpeedConfig (I2C0, 150000);
  ...
}
```

I2C_AddressConfig

Function Name	I2C_AddressConfig
Function Prototype	`void I2C_AddressConfig (I2C_TypeDef *I2Cx, u16 Address, I2C_Addressing Mode);`
Behavior Description	Configures the *I²C* bus address of the interface.
Input Parameter 1	*I2Cx*: specifies the I2C to be configured where *x* can be 0 or 1.
Input Parameter 2	*Address*: the *I²C* bus address of the interface.
Input Parameter 3	*Mode*: specifies the addressing mode. Refer to *I2C addressing modes on page 167* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to configure the address of the interface in the case of 7-bit addressing mode:

```
{
  ...
  I2C_AddressConfig (I2C0, 0xA0, I2C_Mode7);
  ...
}
```

I2C_FCLKConfig

Function Name	I2C_FCLKConfig
Function Prototype	`void I2C_FCLKConfig (I2C_TypeDef *I2Cx);`
Behavior Description	Configures *I²C* frequency bits according to *PCLK1* frequency. The selected I2C must be disabled.
Input Parameter	*I2Cx*: specifies the I2C to be configured where *x* can be 0 or 1.
Output Parameter	None
Return Value	None
Required Preconditions	The *I²C* module is disabled (*PE*=0)
Called Functions	*RCCU_FrequencyValue*

Example:

This example illustrates how to configure the *I2C* frequency according to to PCLK1 frequency:

```
{
  ...
  /* the I2C module must be disabled (PE=0) */
  I2C_FCLKConfig (I2C0);
  ...
}
```

I2C_AddressSend

Function Name	I2C_AddressSend
Function Prototype	`void I2C_AddressSend (I2C_TypeDef *I2Cx, u16 Address, I2C_Addressing Mode, I2C_Direction Direction);`
Behavior Description	Sends the slave address with which the next communication will be performed.
Input Parameter 1	*I2Cx*: where *x* can be 0 or 1 to select the I^2C peripheral which will send the slave address.
Input Parameter 2	*Address*: Indicates the slave address which will be transmitted.
Input Parameter 3	*Mode*: Refer to *I2C addressing modes on page 167* for more details on the allowed values of this parameter
Input Parameter 4	*Direction*: specifies the communication direction. Refer to *I2C transfer direction on page 167* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	*I2C_STARTGenerate*

Example:

This example illustrates how to send the address to slave in case of transmission direction and 7-bit addressing mode:

```
{
  ...
  I2C_AddressSend (I2C0, 0x43, I2C_Mode7, I2C_TX);
  ...
}
```

I2C_ByteSend

Function Name	I2C_ByteSend
Function Prototype	`void I2C_ByteSend (I2C_TypeDef *I2Cx, u8 Data);`
Behavior Description	Transmits a single byte.
Input Parameter 1	*I2Cx*: specifies the I2C which will send the single byte where *x* can be 0 or 1.
Input Parameter 2	*Data*: the byte to be transmitted.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to use the *I2C_ByteSend* function to send a byte:

```
{
  ...
  I2C_ByteSend (I2C0, 0x5D);
  ...
}
```

I2C_TransmissionStatus

Function Name	I2C_TransmissionStatus
Function Prototype	`I2C_Tx_Status I2C_TransmissionStatus (I2C_TypeDef *I2Cx);`
Behavior Description	Reports the current transmission status.
Input Parameter	*I2Cx*: specifies the I2C whose transmission status will be tested where *x* can be 0 or 1.
Output Parameter	None
Return Value	The transmission status. Refer to *I2C transmission status on page 169* for more details on the allowed values of this parameter.
Required Preconditions	START generation. Send slave address.
Called Functions	None

Example:

This example illustrates how to report the status of transmission progress of *I2C0*:

```
{
  I2C_Tx_Status TransmissionStatus;
  ...
  TransmissionStatus = I2C_TransmissionStatus (I2C0);
  ...
}
```

I2C_ByteReceive

Function Name	I2C_ByteReceive
Function Prototype	`u8 I2C_ByteReceive (I2C_TypeDef *I2Cx);`
Behavior Description	Returns the most recent received byte.
Input Parameter	*I2Cx*: specifies the I2C peripheral to get a received data where *x* can be 0 or 1.
Output Parameter	None
Return Value	The value of the received byte.
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to get the byte received:

```
{
  u8 received_byte;
  ...
  received_byte = I2C_ByteReceive (I2C0);
  ...
}
```

I2C_ReceptionStatus

Function Name	I2C_ReceptionStatus
Function Prototype	`I2C_Rx_Status I2C_ReceptionStatus (I2C_TypeDef *I2Cx)`
Behavior Description	Reports the reception status.
Input Parameter	*I2Cx*: where *x* can be 0 or 1 to select the I^2C peripheral which reception status will be tested.
Output Parameter	None
Return Value	The status of reception. Refer to *I2C reception status on page 170* for more details on the allowed values of this parameter.
Required Preconditions	START generation. Send slave address.
Called Functions	None

Example: This example illustrates how to return the status of reception progress:

```
{
  I2C_Rx_Status ReceptionStatus;
  ...
  ReceptionStatus = I2C_ReceptionStatus(I2C0);
  ...
}
```

I2C_ErrorClear

Function Name	I2C_ErrorClear
Function Prototype	`void I2C_ErrorClear (I2C_TypeDef *I2Cx);`
Behavior Description	Clears any error flag.
Input Parameter	I2Cx: specifies the I2C which error flags will be cleared where x can be 0 or 1.
Output Parameter	None
Return Value	None
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to clear all error flags:

```
{
  ...
  I2C_ErrorClear (I2C0);
  ...
}
```

I2C_GetStatus

Function Name	I2C_GetStatus
Function Prototype	`u32 I2C_GetStatus(I2C_TypeDef *I2Cx);`
Behavior Description	Reads the I2C status registers.
Input Parameter	I2Cx: specifies the I2C to get its status registers where x can be 0 or 1.
Output Parameter	None
Return Value	The I2C status registers value.
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to read all status registers:

```
{
  u32 I2C_Status_registers;
I2C_Status_registers = I2C_GetStatus (I2C0);
  ...
}
```

I2C_GetLastEvent

Function Name	I2C_GetLastEvent
Function Prototype	`u16 I2C_GetLastEvent(I2C_TypeDef *I2Cx);`
Behavior Description	Gets the last I2Cx event that has occurred.
Input Parameter	I2Cx: specifies the I2C to get its status registers where x can be 0 or 1.
Output Parameter	None
Return Value	The last happened Event.
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to get the last I2C0 event that has occurred:

```
{
  u16 I2C_Event;
I2C_Event = I2C_GetLastEvent (I2C0);
  ...
}
```

I2C_CheckEvent

Function Name	I2C_CheckEvent
Function Prototype	`FlagStatus I2C_CheckEvent(I2C_TypeDef *I2Cx, u16 I2C_EVENT);`
Behavior Description	Checks whether the Last I2C Event is equal to the one passed as parameter.
Input Parameter 1	I2Cx: specifies the I2C to get its status registers where x can be 0 or 1.
Input Parameter 2	I2C_EVENT: specifies the event to be checked. Refer to *I2C events on page 169* for more details on this parameter.
Output Parameter	None
Return Value	The I2C status registers value.
Required Preconditions	None
Called Functions	None

Example:

This example illustrates how to wait for EV8 event using I2C0:

```
{
....
while(!I2C_CheckEvent(I2C0,
I2C_EVENT_MASTER_BYTE_TRANSMITTED));
  ...
}
```

3.13 Controller area network (CAN)

The CAN driver may be used to exchange data between interconnected devices sharing a CAN bus compliant with the CAN 2.0 B standard. The application can use either polling mode or interrupt mode to handle the transmission and reception of frames.

The first section describes the data structures used in the CAN firmware library. The second section presents the CAN firmware library functions.

In this chapter, the terms “message” and “frame” will be alternatively used; they both designate a standard data packet of variable length.

3.13.1 Data structures

CAN registers’ structure

The *CAN* registers’ structure *CAN_TypeDef* is defined in the *71x_map.h* file as follows:

```
typedef volatile struct
{
  vu16 CR;
  vu16 EMPTY1;
  vu16 SR;
  vu16 EMPTY2;
  vu16 ERR;
  vu16 EMPTY3;
  vu16 BTR;
  vu16 EMPTY4;
  vu16 IDR;
  vu16 EMPTY5;
  vu16 TESTR;
  vu16 EMPTY6;
  vu16 BRPR;
  vu16 EMPTY7[3];
  CAN_MsgObj_TypeDef sMsgObj[2];
  vu16 EMPTY8[16];
  vu16 TR1R;
  vu16 EMPTY9;
  vu16 TR2R;
  vu16 EMPTY10[13];
  vu16 ND1R;
  vu16 EMPTY11;
  vu16 ND2R;
  vu16 EMPTY12[13];
  vu16 IP1R;
  vu16 EMPTY13;
  vu16 IP2R;
  vu16 EMPTY14[13];
  vu16 MV1R;
  vu16 EMPTY15;
  vu16 MV2R;
  vu16 EMPTY16;
} CAN_TypeDef;
```

This structure embeds another structure named *CAN_MsgObj_TypeDef* to implement the message interface registers, defined as follows:

```
typedef volatile struct
{
  vu16 CRR;
  vu16 EMPTY1;
  vu16 CMR;
  vu16 EMPTY2;
  vu16 M1R;
  vu16 EMPTY3;
  vu16 M2R;
  vu16 EMPTY4;
  vu16 A1R;
  vu16 EMPTY5;
  vu16 A2R;
  vu16 EMPTY6;
  vu16 MCR;
  vu16 EMPTY7;
  vu16 DA1R;
  vu16 EMPTY8;
  vu16 DA2R;
  vu16 EMPTY9;
  vu16 DB1R;
  vu16 EMPTY10;
  vu16 DB2R;
  vu16 EMPTY11[27];
} CAN_MsgObj_TypeDef;
```

Table 78 describes the CAN structure fields.

Table 78. CAN structure fields

Register	Description
CR	Control Register
SR	Status Register
ERR	Error Counter
BTR	Bit Timing Register
IDR	Interrupt Identifier Register
TESTR	Test Register
BRPR	BRP Extension Register
TR1R	Transmission Request 1
TR2R	Transmission Request 2
ND1R	New Data 1
ND2R	New Data 2
IP1R	Interrupt Pending 1 Register
IP2R	Interrupt Pending 2 Register

Table 78. CAN structure fields (continued)

Register	Description
MV1R	Message Valid 1 Register
MV2R	Message Valid 2 Register

Table 79 describes the *CAN* message interface structure fields.

Table 79. CAN message interface structure fields

Register	Description
CRR	Command Request Register
CMR	Command Mask Register
M1R	Mask 1 Register
M2R	Mask 2 Register
A1R	Message Arbitration 1 Register
A2R	Message Arbitration 2 Register
MCR	Message Control Register
DA1R	Data A 1 Register
DA2R	Data A 2 Register
DB1R	Data B 1 Register
DB2R	Data B 2 Register

The *CAN* peripheral is also declared in the *71x_map.h* file:

```
...
#define APB1_BASE  0xC0000000
...
#define CAN_BASE   (APB1_BASE + 0x9000)
...
#ifndef DEBUG
  ...
#ifdef _CAN
#define CAN   ((CAN_TypeDef   *)CAN_BASE)
#endif
  ...
#else
  ...
  #ifdef _CAN
  EXT CAN_TypeDef  *CAN;
  #endif
  ...
#endif
```

When debug mode is used, *CAN* pointer is initialized in the file *71x_lib.c*:

```
#ifdef _CAN
  CAN   = (CAN_TypeDef  *)CAN_BASE;
#endif /* _CAN */
```

In order to access the peripheral registers, *_CAN* must be defined in the file *71x_conf.h* as follows:

```
#define _CAN
```

Some *XTI* and *PCU* functions are called, *_XTI* and *_PCU* must be defined, in *71x_conf.h* file, to make the *XTI* and *PCU* functions accessible:

```
#define _PCU
#define _XTI
```

CAN standard bitrates

The following enumeration defines the different standard bitrates available. It is defined in the file *can.h*:

```
enum
{
  CAN_BITRATE_100K,
  CAN_BITRATE_125K,
  CAN_BITRATE_250K,
  CAN_BITRATE_500K,
  CAN_BITRATE_1M
};
```

Table 80 describes the standard bitrates of the CAN with their timing parameters.

Table 80. Standard CAN bitrates

Bitrate name	Bitrate	NTQ	TSEG1	TSEG2	SJW	BRP
CAN_BITRATE_100K	100 kbit/s	16	11	4	4	5
CAN_BITRATE_125K	125 kbit/s	16	11	4	4	4
CAN_BITRATE_250K	250 kbit/s	8	4	3	3	4
CAN_BITRATE_500K	500 kbit/s	16	16	2	1	1
CAN_BITRATE_1M	1 Mbit/s	8	4	3	1	1

Where;

NTQ: Number of Time Quantum
TSEG1: Time Segment before the sampling point
TSEG2: Time Segment after the sampling point
SJW: Synchronization Jump Width
BRP: Baud Rate Prescaler

CAN control register bits

The following defines list the bit fields accessible in the CAN control register. They are declared in the file *can.h*:

```
#define CAN_CR_TEST    0x0080
#define CAN_CR_CCE     0x0040
#define CAN_CR_DAR     0x0020
#define CAN_CR_EIE     0x0008
#define CAN_CR_SIE     0x0004
#define CAN_CR_IE      0x0002
#define CAN_CR_INIT    0x0001
```

Table 81 describes the CAN control register bits.

Table 81. CAN control register bits

Bit mnemonic	Description
CAN_CR_TEST	Test mode
CAN_CR_CCE	Configuration Change Enable
CAN_CR_DAR	Disable Automatic Retransmission
CAN_CR_EIE	Error Interrupt Enable
CAN_CR_SIE	Status Interrupt Enable
CAN_CR_IE	Interrupt Enable
CAN_CR_INIT	Initialization

CAN status register bits

The following defines list the bit fields accessible in the CAN status register. They are declared in the file *can.h*:

```
#define CAN_SR_LEC      0x0007
#define CAN_SR_TXOK     0x0008
#define CAN_SR_RXOK     0x0010
#define CAN_SR_EPASS    0x0020
#define CAN_SR_EWARN    0x0040
#define CAN_SR_BOFF     0x0080
```

Table 82 describes the CAN status register bits.

Table 82. CAN status register bits

Bit mnemonic	Description
CAN_SR_LEC	Last Error Code mask
CAN_SR_TXOK	Transmission successful
CAN_SR_RXOK	Reception successful
CAN_SR_EPASS	Error Passive State
CAN_SR_EWARN	Warning State
CAN_SR_BOFF	Busoff State

CAN test register bits

The following defines list the bit fields accessible in the CAN test register. They are declared in the file *can.h*:

```
#define CAN_TESTR_RX        0x0080
#define CAN_TESTR_TX1       0x0040
#define CAN_TESTR_TX0       0x0020
#define CAN_TESTR_LBACK     0x0010
#define CAN_TESTR_SILENT    0x0008
#define CAN_TESTR_BASIC     0x0004
```

Table 83 describes the CAN test register bits.

Table 83. CAN test register bits

Bit mnemonic	Description
CAN_TESTR_RX	CAN RX pin monitoring
CAN_TESTR_TX1	CAN TX pin monitoring
CAN_TESTR_TX0	
CAN_TESTR_LBACK	Loopback mode In this mode, the *CAN* core has an internal loopback of TX to RX, and the *CAN* RX pin is logically disconnected from the bus. However, the *CAN* TX pin is still connected to the bus.
CAN_TESTR_SILENT	Silent mode In this mode, the *CAN* core has an internal loopback of TX to RX, and the *CAN* TX pin is logically disconnected from the bus and stuck to a recessive state. However, the *CAN* RX pin is still connected to the bus.
CAN_TESTR_BASIC	Basic mode This mode is used to minimize the resources needed to exchange data frames for a given node. The message RAM is not used anymore and there are only two dedicated message objects: the first one to transmit, the second to receive.

CAN message interface registers

The following defines list the bit fields accessible in the CAN Message Interface registers. They are declared in the file *can.h*:

```
/*IFx Command Request register */
#define CAN_CRR_BUSY        0x8000

/*IFn Command Mask register */
#define CAN_CMR_WRRD        0x0080
#define CAN_CMR_MASK        0x0040
#define CAN_CMR_ARB         0x0020
#define CAN_CMR_CONTROL     0x0010
#define CAN_CMR_CLRINTPND   0x0008
#define CAN_CMR_TXRQST      0x0004
#define CAN_CMR_DATAA       0x0002
#define CAN_CMR_DATAB       0x0001

/* IFn Mask 2 register */
#define CAN_M2R_MXTD        0x8000
#define CAN_M2R_MDIR        0x4000


/*IFn Arbitration 2 register */
#define CAN_A2R_MSGVAL      0x8000
#define CAN_A2R_XTD         0x4000
#define CAN_A2R_DIR         0x2000

/* IFn Message Control register */
#define CAN_MCR_NEWDAT      0x8000
```

```
#define CAN_MCR_MSGLST      0x4000
#define CAN_MCR_INTPND      0x2000
#define CAN_MCR_UMASK       0x1000
#define CAN_MCR_TXIE        0x0800
#define CAN_MCR_RXIE        0x0400
#define CAN_MCR_RMTEN       0x0200
#define CAN_MCR_TXRQST      0x0100
#define CAN_MCR_EOB         0x0080
```

Table 84 describes the CAN message interface register bits.

Table 84. CAN message interface register bits

Bit mnemonic	Description
CAN_CRR_BUSY	Command Request register / Busy flag
CAN_CMR_WRRD	Command Mask register / Write access
CAN_CMR_MASK	Command Mask register / Mask access
CAN_CMR_ARB	Command Mask register / Arbitration access
CAN_CMR_CONTROL	Command Mask register / Control access
CAN_CMR_CLRINTPND	Command Mask register / Clear interrupt pending
CAN_CMR_TXRQST	Command Mask register / Transmit request release and New data access
CAN_CMR_DATAA	Command Mask register / Data bytes 0-3 access
CAN_CMR_DATAB	Command Mask register / Data bytes 4-7 access
CAN_M2R_MXTD	Mask register / Mask extended identifier
CAN_M2R_MDIR	Mask register / Mask message direction
CAN_A2R_MSGVAL	Arbitration register / Message valid flag
CAN_A2R_XTD	Arbitration register / Extended identifier
CAN_A2R_DIR	Arbitration register / Message direction
CAN_MCR_NEWDAT	Message Control register / New Data
CAN_MCR_MSGLST	Message Control register / Message Lost
CAN_MCR_INTPND	Message Control register / Interrupt Pending
CAN_MCR_UMASK	Message Control register / Use Acceptance Mask
CAN_MCR_TXIE	Message Control register / Transmit Interrupt Enable
CAN_MCR_RXIE	Message Control register / Receive Interrupt Enable
CAN_MCR_RMTEN	Message Control register / Remote frame Enable
CAN_MCR_TXRQST	Message Control register / Transmit Request
CAN_MCR_EOB	Message Control register / End of Buffer

Wake-up modes

The following defines list wake-up modes available on the CAN cell. They are declared in the file *can.h*:

```
enum
{
    CAN_WAKEUP_ON_EXT,
    CAN_WAKEUP_ON_CAN
};
```

Table 85 describes the CAN wake-up modes.

Table 85. CAN wake-up modes

Wake-up mode	Description
CAN_WAKEUP_ON_EXT	Wake-up on external event The *CAN* cell is woken up by a falling edge on the I/O port 2.8.
CAN_WAKEUP_ON_CAN	Wake-up on *CAN* bus activity The *CAN* cell is woken up by a dominant state of the *CAN* bus (i.e. falling edge on the *CAN* RX pin = port 1.11)

CAN message structure

The structure that contains message data is defined as follows, and is declared in the file *can.h*:

```
typedef struct
{
    int IdType;
    u32 Id;
    u8 Dlc;
    u8 Data[8];
} canmsg;
```

Table 86 describes the CAN message structure parameters.

Table 86. CAN message structure parameters

CAN message parameter	Description
IdType	Identifier type
Id	Identifier value
Dlc	Data Length Code
Data[]	Array containing data values

CAN message identifier types

The different CAN message identifier types are listed below, and are declared in the file *can.h*:

```
enum
{
    CAN_STD_ID,
    CAN_EXT_ID
};
```

Table 87 describes the CAN message identifier types.

Table 87. CAN message identifier types

ID type	Description
CAN_STD_ID	Standard identifier (11-bit)
CAN_EXT_ID	Extended identifier (29-bit)

CAN message identifier limits

The identifier limit values for each type are listed below, and are declared in the file *can.h*:

```
#define CAN_LAST_STD_ID    ((1<<11) - 1)
#define CAN_LAST_EXT_ID    ((1L<<29) - 1)
```

Table 88 describes the CAN identifier limit values.

Table 88. CAN identifier limit values

ID value	Description
CAN_LAST_STD_ID	Maximum standard identifier = 0x7FF
CAN_LAST_EXT_ID	Maximum extended identifier = 0x1FFFFFFF

3.13.2 Firmware library functions

Table 89 enumerates the different functions of the CAN library.

Table 89. CAN library functions

Function Name	Description
CAN_EnterInitMode	Switches the CAN into initialization mode.
CAN_LeaveInitMode	Leaves the initialization mode (switch into normal mode).
CAN_EnterTestMode	Switches the CAN into test mode.
CAN_LeaveTestMode	Leaves the current test mode (switch into normal mode).
CAN_SetBitrate	Sets up a standard CAN bitrate.
CAN_SetTiming	Sets up the CAN timing with specific parameters.
CAN_SleepRequest	Requests the CAN cell to enter sleep mode.
CAN_SetUnusedMsgObj	Configures the message object as unused.
CAN_SetTxMsgObj	Configures the message object as TX.

Table 89. CAN library functions (continued)

Function Name	Description
CAN_SetRxMsgObj	Configures the message object as RX.
CAN_SetUnusedAllMsgObj	Configures all the message objects as unused.
CAN_Init	Initializes the CAN cell and set the bitrate.
CAN_ReleaseMessage	Releases the message object.
CAN_ReleaseTxMessage	Releases the transmit message object.
CAN_ReleaseRxMessage	Releases the receive message object
CAN_UpdateMsgObj	Updates the message object.
CAN_TransmitRequest	Requests the transmission of a message object. A data or remote frame is sent.
CAN_SendMessage	Starts transmission of a message.
CAN_ReceiveMessage	Gets the message, if received.
CAN_WaitEndOfTx	Waits until current transmission is finished.
CAN_BasicSendMessage	Starts transmission of a message in BASIC mode.
CAN_BasicReceiveMessage	Gets the message in BASIC mode, if received.
CAN_GetMsgReceiveStatus	Tests the waiting status of a received message.
CAN_GetMsgTransmitRequestStatus	Tests the request status of a transmitted message.
CAN_GetMsgInterruptStatus	Tests the interrupt status of a message object.
CAN_GetMsgValidStatus	Tests the validity of a message object (ready to use).
CAN_GetFlagStatus	Returns the state of the CAN flags: TxOK, RxOK, EPASS, EWARN and BOFF.
CAN_GetTransmitErrorCounter	Gets the CAN transmit Error counter.
CAN_GetReceiveErrorCounter	Gets the CAN receive Error counter.

CAN_EnterInitMode

Function Name	CAN_EnterInitMode
Function Prototype	`void CAN_EnterInitMode(u8 mask);`
Behavior Description	Switches the *CAN* into initialization mode. This function must be used in conjunction with *CAN_LeaveInitMode*.
Input Parameter	*mask*: any binary value formed using the values defined in *CAN control register bits on page 187* .
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None
See also	*CAN_Init on page 202*, *CAN_LeaveInitMode on page 194*

Example:

This example illustrates one method to initialize the *CAN*:

```
{
  ...
  /* Initialize the CAN and enable interrupts */
  CAN_EnterInitMode(CAN_CR_IE);
  ...
}
```

CAN_LeaveInitMode

Function Name	CAN_LeaveInitMode
Function Prototype	`void CAN_LeaveInitMode(void);`
Behavior Description	Leaves the initialization mode (switch into normal mode). This function must be used in conjunction with *CAN_EnterInitMode*.
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None
See also	*CAN_EnterInitMode on page 194*

Example:

This example illustrates how to leave the initialization mode.

```
{
  ...
  CAN_LeaveInitMode();
  ...
}
```

CAN_EnterTestMode

Function Name	CAN_EnterTestMode
Function Prototype	`void CAN_EnterTestMode(u8 mask);`
Behavior Description	Switches the *CAN* into test mode.
Input Parameter	*mask*: any binary value formed using the values defined in *CAN test register bits on page 188*.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to enter any test mode.

```
{
  ...
  /* Switch the CAN into Loopback mode, i.e. RX is disconnected
     from the bus, and TX is internally linked to RX */
  CAN_EnterTestMode(CAN_TESTR_LBACK);
  ...
}
```

CAN_LeaveTestMode

Function Name	CAN_LeaveTestMode
Function Prototype	`void CAN_LeaveTestMode(void);`
Behavior Description	Leaves the current test mode (switch into normal mode).
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to leave the current test mode.

```
{
  ...
  CAN_LeaveTestMode();
  ...
}
```

CAN_SetBitrate

Function Name	CAN_SetBitrate
Function Prototype	`void CAN_SetBitrate(int bitrate);`
Behavior Description	Sets up a standard CAN bitrate.
Input Parameter	*bitrate*: one of the *CAN_BITRATE_xxx* defines. Refer to *CAN standard bitrates on page 187* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	The CAN must be in initialization mode. PCLK1 must be at 8 MHz, otherwise, refer to *CAN_SetTiming on page 196*.
Called Functions	None

Example:

This example illustrates how to set a standard bitrate for the *CAN*.

```
{
  ...
  // Enable the configuration change bit, to set the bitrate
  CAN_EnterInitMode(CAN_CR_CCE);
  CAN_SetBitrate(CAN_BITRATE_100K);
  CAN_LeaveInitMode();
  ...
}
```

CAN_SetTiming

Function Name	CAN_SetTiming
Function Prototype	`void CAN_SetTiming(u32 tseg1, u32 tseg2, u32 sjw, int brp);`
Behavior Description	Sets up the *CAN* timing with specific parameters.
Input Parameter 1	tseg1: Time Segment before the sample point position. It can take values from 1 to 16.
Input Parameter 2	tseg2: Time Segment after the sample point position. It can take values from 1 to 8.
Input Parameter 3	sjw: Synchronisation Jump Width. It can take values from 1 to 4.
Input Parameter 4	brp: Baud Rate Prescaler. It can take values from 1 to 1024.
Output Parameter	None
Return Value	None
Required preconditions	The *CAN* must be in initialization mode.
Called Functions	None

Example:

This example illustrates how to set specific timing parameters for the *CAN*.

```
{
  ...
  /* Enable the configuration change bit, to set the specific
     timing parameters: TSEG1=11, TSEG2=4, SJW=4, BRP=5 */
  CAN_EnterInitMode(CAN_CR_CCE);
  CAN_SetTiming(11, 4, 4, 5);
  CAN_LeaveInitMode();
  ...
}
```

CAN_SleepRequest

Function Name	CAN_SleepRequest
Function Prototype	`void CAN_SleepRequest(u32 WakeupMode);`
Behavior Description	Requests the *CAN* cell to enter sleep mode.
Input Parameter	WakeupMode: using one of the values defined in *Wake-up modes on page 191*.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	*XTI_Init on page 79*, *XTI_LineModeConfig on page 81*, *XTI_LineConfig on page 82*, *XTI_ModeConfig on page 80*, *XTI_InterruptLineValue on page 82*, *XTI_PendingBitClear on page 83*, *PCU_STOP on page 27*

Example:

This example illustrates how to activate the *CAN* cell sleep mode.

```
{
  ...
  CAN_SleepRequest(CAN_WAKEUP_ON_CAN);
  /* Note that the XTI interrupt handler is called as soon as the
     wake-up condition is reached */
  ...
}
```

CAN_SetUnusedMsgObj

Function Name	CAN_SetUnusedMsgObj
Function Prototype	`u32 CAN_SetUnusedMsgObj(u32 msgobj);`
Behavior Description	Configures the message object as unused. The hardware will not process it until it is setup as RX or TX.
Input Parameter	*msgobj*: message object number, from 0 to 31.
Output Parameter	None
Return Value	1: if interface is found 0: if no interface is available
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to configure some message objects so that they will not be used.

```
{
  ...
  for(i=16; i<=31; i++)
    CAN_SetUnusedMsgObj(i);
  ...
}
```

CAN_SetTxMsgObj

Function Name	CAN_SetTxMsgObj
Function Prototype	`u32 CAN_SetTxMsgObj(u32 msgobj, u32 idType, FunctionalState RemoteEN);`
Behavior Description	Configures the message object as TX.
Input Parameter 1	*msgobj*: message object number, from 0 to 31.
Input Parameter 2	*idType*: message identifier type defined using the values described in *CAN message identifier types on page 192*.
Input Parameter 3	RemoteEN: If set to ‘1’, the remote function is enabled. Otherwise, the remote function is disabled.
Output Parameter	None
Return Value	1: if interface is found 0: if no interface is available
Required preconditions	None
Called Functions	None

Example:

This example describes how to configure a transmit message object.

```
{
  ...
  /* Defines the transmit message object 0 with standard
     identifiers and disable the remote function */
  CAN_SetTxMsgObj(0, CAN_STD_ID, DISABLE);
  ...
}
```

Note: When defining which message object number to use for TX or RX, you must take into account the priority levels in the objects processing. The lower number (0) has the highest priority and the higher number (31) has the lowest priority, whatever their type.

It is also not recommended to have “holes” in the objects list for optimal performance. A typical usage of the message objects is, from low to high numbers:

- transmit objects
- receive objects with filtering (fixed ID)
- receive objects with filtering (ID range)
- receive objects without filtering,
- unused objects

independently of the FIFO depth.

CAN_SetRxMsgObj

Function Name	CAN_SetRxMsgObj
Function Prototype	`u32 CAN_SetRxMsgObj(u32 msgobj, u32 idType, u32 idLow, u32 idHigh, bool singleOrFifoLast);`
Behavior Description	Configures the message object as RX.
Input Parameter 1	*msgobj*: message object number, from 0 to 31.
Input Parameter 2	*idType*: message identifier type, defined using the values described in *CAN message identifier types on page 192*.
Input Parameter 3	*idLow*: low part of the identifier range used for acceptance filtering. It can take values from 0 to 0x7FF for standard ID, and values from 0 to 0x1FFFFFFF for extended ID.
Input Parameter 4	*idHigh*: high part of the identifier range used for acceptance filtering. It can take values from 0 to 0x7FF for standard ID, and values from 0 to 0x1FFFFFFF for extended ID. idHigh must be above idLow. For more convenience, use one of the following values to set the maximum ID: *CAN_LAST_STD_ID* or *CAN_LAST_EXT_ID* Refer to *CAN message identifier limits on page 192* for more details on the allowed values of this parameter.
Input Parameter 5	*singleOrFifoLast*: End-of-buffer indicator, it can take the following values: – *TRUE* for a single receive object or a FIFO receive object that is the last one of the FIFO – *FALSE* for a FIFO receive object that is not the last one
Output Parameter	None
Return Value	1: if interface is found 0: if no interface is available
Required preconditions	None
Called Functions	None

Example:

This example describes how to configure a receive message object.

```
{
  ...
  /* Define a receive FIFO of depth 2 (objects 0 and 1) for
     standard identifiers, in which IDs are filtered in the
     range 0x400-0x5FF */
  CAN_SetRxMsgObj(0, CAN_STD_ID, 0x400, 0x5FF, FALSE);
  CAN_SetRxMsgObj(1, CAN_STD_ID, 0x400, 0x5FF, TRUE);

  /* Define a single receive object for extended identifiers, in
     which all IDs are filtered in */
  CAN_SetRxMsgObj(2, CAN_EXT_ID, 0, CAN_LAST_EXT_ID, TRUE);
  ...
}
```

Note: Care must be taken when defining an ID range: all combinations of idLow and idHigh will not always produce the expected result, because of the way identifiers are filtered by the hardware.

The criteria applied to keep a received frame is as follows:

(received ID) AND (ID mask) = (ID arbitration), where AND is a bitwise operator.

Consequently, it is generally better to choose for idLow a value with some LSBs cleared, and for idHigh a value that "logically contains" idLow and with the same LSBs set.

Example: the range 0x100-0x3FF will work, but the range 0x100-0x2FF will not because 0x100 is not logically contained in 0x2FF (that is, 0x100 and 0x2FF = 0).

CAN_SetUnusedAllMsgObj

Function Name	CAN_SetUnusedAllMsgObj
Function Prototype	`u32 CAN_InvalidateAllMsgObj(void);`
Behavior Description	Configures all the message objects as unused.
Input Parameter	None
Output Parameter	None
Return Value	1, if all message objects are set to unused. Otherwise, 0.
Required preconditions	None
Called Functions	*CAN_SetUnusedMsgObj on page 198*

Example:

This example describes how to invalidate all the message objects.

```
{
  ...
  CAN_SetUnusedAllMsgObj();
/* now, some objects can be set up */
  ...
}
```

CAN_Init

Function Name	CAN_Init
Function Prototype	`void CAN_Init(u8 mask, u32 bitrate);`
Behavior Description	Initializes the *CAN* cell and set the bitrate.
Input Parameter 1	*mask*: any binary value defined using the values described in *CAN control register bits on page 187*.
Input Parameter 2	*bitrate*: one of the *CAN_BITRATE_xxx* defines. Refer to *CAN standard bitrates on page 187* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	PCLK1 must be 8 MHz. Otherwise refer to *CAN_SetTiming on page 196*.
Called Functions	*CAN_EnterInitMode on page 194*, *CAN_SetBitrate on page 196*, *CAN_LeaveInitMode on page 194*, *CAN_LeaveTestMode on page 195*

Example:

This example illustrates a typical *CAN* initialization.

```
{
  ...
  /* Initialize the CAN at 100 kbit/s and enable interrupts */
  CAN_Init(CAN_CR_IE, CAN_BITRATE_100K);
  ...
}
```

CAN_ReleaseMessage

Function Name	CAN_ReleaseMessage
Function Prototype	`u32 CAN_ReleaseMessage(u32 msgobj);`
Behavior Description	Releases the message object.
Input Parameter	*msgobj*: message object number, from 0 to 31.
Output Parameter	None
Return Value	1: if interface is found 0: if no interface is available
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to release a message object.

```
{
  ...
```

```
  /* Release the message object 0 */
  CAN_ReleaseMessage(0);
  ...
}
```

CAN_ReleaseTxMessage

Function Name	CAN_ReleaseTxMessage
Function Prototype	void CAN_ReleaseTxMessage(u32 msgobj);
Behavior Description	Releases the transmit message object.
Input Parameter	*msgobj*: message object number, from 0 to 31.
Output Parameter	None
Return Value	None
Required preconditions	It is assumed that message interface 0 is always used for transmission.
Called Functions	None

Example:

This example illustrates how to release a transmit message object.

```
{
  ...
  /* Release the transmit message object 0 */
  CAN_ReleaseTxMessage(0);
  ...
}
```

CAN_ReleaseRxMessage

Function Name	CAN_ReleaseRxMessage
Function Prototype	`void CAN_ReleaseRxMessage(u32 msgobj);`
Behavior Description	Releases the receive message object.
Input Parameter	*msgobj*: message object number, from 0 to 31.
Output Parameter	None
Return Value	None
Required preconditions	It is assumed that message interface 1 is always used for reception.
Called Functions	None

Example:

This example illustrates how to release a receive message object.

```
{
  ...
  /* Release the receive message object 0 */
  CAN_ReleaseTxMessage(0);
  ...
}
```

CAN_UpdateMsgObj

Function Name	CAN_UpdateMsgObj
Function Prototype	`u32 CAN_UpdateMsgObj(u32 msgobj, canmsg pCanMsg);`
Behavior Description	Updates the message object passed in parameter with the pCanMsg.
Input Parameter 1	*msgobj*: message object number, from 0 to 31.
Input Parameter 2	*pCanMsg*: pointer to the canmsg structure that contains the data to transmit: ID type, ID value, data length, data values. Refer to *CAN message structure on page 191* for more details.
Output Parameter	None
Return Value	1: if interface is found 0: if no interface is available
Required preconditions	It is assumed that message interface 0 is used to update a can message object.
Called Functions	None

Example:

This example illustrates how to update a message object already configured to transmit.

```
{
  ...
canmsg CanMsg = { CAN_STD_ID, 0x111, 4, {0x10, 0x20, 0x40, 0x80}
};
  /* Update CAN Message 0 */
  CAN_UpdateMsgObj(0, &CanMsg);
  ...
}
```

CAN_TransmitRequest

Function Name	CAN_TransmitRequest
Prototype	`u32 CAN_TransmitRequest( u32 msgobj);`
Behavior Description	Starts the transmission of a messsage object. A data frame is transmitted if the message object is configured in transmission mode. A remote frame is transmitted if the message object is configured in reception mode.
Input Parameter	msgobj: The message object number, from 0 to 31.
Output Parameter	None
Return Value	1: if interface is found 0: if no interface is available
Required preconditions	The message object must have been set up properly.

Example:

This example illustrates how to request the transmission of a data frame.

```
{
  ...
/* Message object 0 is already configured for transmission*/
/* Request the transmission of a data frame */
  CAN_TransmitRequest(0);
...
}
```

CAN_SendMessage

Function Name	CAN_SendMessage
Function Prototype	`u32 CAN_SendMessage(u32 msgobj, canmsg* pCanMsg);`
Behavior Description	Starts transmission of a message.
Input Parameter 1	*msgobj*: message object number, from 0 to 31.
Input Parameter 2	*pCanMsg*: pointer to the canmsg structure that contains the data to transmit: ID type, ID value, data length, data values. Refer to *CAN message structure on page 191* for more details.
Output Parameter	None
Return Value	1 if transmission was OK, else 0
Required preconditions	The message object must have been set up properly.
Called Functions	`CAN_UpdateMsgObj()` `CAN_TransmitRequest()`

Example:

This example illustrates how to send a single message.

```
{
  ...
  canmsg CanMsg = { CAN_STD_ID, 0x111, 4, {0x10, 0x20, 0x40,
0x80} };
  /* Send a standard ID data frame containing 4 data values */
  CAN_SendMessage(0, &CanMsg);
  ...
}
```

CAN_ReceiveMessage

Function Name	CAN_ReceiveMessage
Function Prototype	`u32 CAN_ReceiveMessage(u32 msgobj, bool release, canmsg* pCanMsg);`
Behavior Description	Gets the message, if received.
Input Parameter 1	*msgobj*: message object number, from 0 to 31.
Input Parameter 2	*release*: message release indicator, it can take the following values: – *TRUE*: the message object is released at the same time as it is copied from message RAM, then it is free for next reception – *FALSE*: the message object is not released, it is to the caller to do it
Input Parameter 3	*pCanMsg*: pointer to the canmsg structure where the received message is copied. Refer to *CAN message structure on page 191* for more details.
Output Parameter	None
Return Value	1 if reception was OK, else 0 (no message pending)
Required preconditions	The message object must have been set up properly.
Called Functions	*CAN_GetMsgReceiveStatus on page 209*

Example:

This example illustrates how to receive a single message.

```
{
  ...
  canmsg CanMsg;
  /* Receive a message in the object 0 and ask for release */
  if (CAN_ReceiveMessage(0, TRUE, &CanMsg))
  {
    /* Check or copy the message contents */
  }
  else
  {
    /* Error handling */
  }
  ...
}
```

CAN_WaitEndOfTx

Function Name	CAN_WaitEndOfTx
Function Prototype	`void CAN_WaitEndOfTx(void);`
Behavior Description	Waits until current transmission is finished. This function should be called between two consecutive transmissions to ensure the latest frame has been completely emitted on the bus, and therefore cannot be aborted anymore.
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	A message must have been sent before.
Called Functions	None

Example:

This example illustrates how to wait for the end of transmission of the latest frame sent.

```
{
  ...
  /* Send consecutive data frames using message object 0 */
  for (i = 0; i < 10; i++)
  {
    CAN_SendMessage(0, CanMsgTable[i]);
    CAN_WaitEndOfTx();
  }
  ...
}
```

CAN_BasicSendMessage

Function Name	CAN_BasicSendMessage
Function Prototype	`u32 CAN_BasicSendMessage(canmsg* pCanMsg);`
Behavior Description	Starts transmission of a message in BASIC mode. Refer to *CAN test register bits on page 188* for more details on the Basic mode.
Input Parameter	*pCanMsg*: pointer to the canmsg structure that contains the data to transmit: ID type, ID value, data length, data values. Refer to *CAN message structure on page 191* for more details.
Output Parameter	None
Return Value	1 if transmission was OK, else 0
Required preconditions	The *CAN* must have been switched into BASIC mode.
Called Functions	None

Example:

This example illustrates how to send a single message.

```
{
  ...
  canmsg CanMsg = { CAN_STD_ID, 0x111, 4, {0x10, 0x20, 0x40,
0x80} };
  CAN_BasicSendMessage(0, &CanMsg);
  ...
}
```

CAN_BasicReceiveMessage

Function Name	CAN_BasicReceiveMessage
Function Prototype	`u32 CAN_BasicReceiveMessage(canmsg* pCanMsg);`
Behavior Description	Gets the message in BASIC mode, if received. Refer to *CAN test register bits on page 188* for more details on the Basic mode.
Input Parameter	*pCanMsg*: pointer to the canmsg structure where the received message is copied. Refer to *CAN message structure on page 191* for more details.
Output Parameter	None
Return Value	1 if reception was OK, else 0 (no message pending)
Required preconditions	The *CAN* must have been switched into BASIC mode.
Called Functions	None

Example:

This example illustrates how to receive a single message in Basic mode.

```
{
  ...
  canmsg CanMsg;
  /* Receive a message */
  if (CAN_BasicReceiveMessage(&CanMsg))
  {
    /* Check or copy the message contents */
  }
  else
  {
    /* Error handling */
  }
  ...
}
```

CAN_GetMsgReceiveStatus

Function Name	CAN_GetMsgReceiveStatus
Function Prototype	`FlasgStatus CAN_GetMsgReceiveStatus(u32 msgobj);`
Behavior Description	Tests the waiting status of a received message.
Input Parameter	*msgobj*: message object number, from 0 to 31.
Output Parameter	None
Return Value	1 if the corresponding message object has received a message waiting to be copied, else 0.
Required preconditions	The corresponding message object must have been set as RX.
Called Functions	None

Example:

This example illustrates how to test the waiting status of a message.

```
{
  ...
  /* Test if a message is pending in the receive message
     object 0 */
  if (CAN_GetMsgReceiveStatus(0))
  {
    /* Receive the message from this message object (i.e. get its
       data from message RAM) */
  }
  ...
}
```

CAN_GetMsgTransmitRequestStatus

Function Name	CAN_GetMsgTransmitRequestStatus
Function Prototype	`FlasgStatus CAN_GetMsgTransmitRequestStatus(u32 msgobj);`
Behavior Description	Tests the request status of a transmitted message.
Input Parameter	*msgobj*: message object number, from 0 to 31.
Output Parameter	None
Return Value	1 if the corresponding message is requested to transmit, else 0.
Required preconditions	A message must have been sent before.
Called Functions	None

Example:

This example illustrates how to test transmit request status of a message.

```
{
  ...
  /* Send a message using object 0 */
  CAN_SendMessage(0, &CanMsg);
  /* Wait for the end of transmit request */
  while (CAN_GetMsgTransmitRequestStatus(0));
  /* Now, the message is being processed by the priority handler
     of the CAN cell, and ready to be emitted on the bus */
  ...
}
```

CAN_GetMsgInterruptStatus

Function Name	CAN_GetMsgInterruptStatus
Function Prototype	`FlagStatus CAN_GetMsgInterruptStatus(u32 msgobj);`
Behavior Description	Tests the interrupt status of a message object.
Input Parameter	*msgobj*: message object number, from 0 to 31.
Output Parameter	None
Return Value	1 if the corresponding message has an interrupt pending, else 0.
Required preconditions	The interrupts must have been enabled.
Called Functions	None

Example:

This example illustrates how to test the waiting status of a message.

```
{
  ...
  /* Send a message using object 0 */
  CAN_SendMessage(0, &CanMsg);
/* Wait for the TX interrupt */
  while (!CAN_GetMsgInterruptStatus(0));
  ...
}
```

CAN_GetMsgValidStatus

Function Name	CAN_GetMsgValidStatus
Function Prototype	`FlasgStatus CAN_GetMsgValidStatus(u32 msgobj);`
Behavior Description	Tests the validity of a message object (ready to use). A valid object means that it has been set up either as TX or as RX, and so is used by the hardware.
Input Parameter	*msgobj*: message object number, from 0 to 31.
Output Parameter	None
Return Value	1 if the corresponding message object is valid, else 0.
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to test the validity of a message object.

```
{
  ...
  if (CAN_GetMsgValidStatus(10))
  {
    /* Do something with message object 10 */
  }
}
```

CAN_GetFlagStatus

Function Name	CAN_GetFlagStatus
Prototype	`FlasgStatus CAN_GetFlagStatus( u32 CAN_Flag);`
Behavior Description	Returns the state of the CAN flags: TxOK, RxOK, EPASS, EWARN and BOFF
Input Parameter	One of the following: - CAN_SR_TXOK - CAN_SR_RXOK - CAN_SR_EPASS - CAN_SR_EWARN - CAN_SR_BOFF
Output Parameter	None
Return Value	1 if the flag passed in parameter is set, else 0.
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to read the Ewarning status of the CAN cell.

```
{
  ...
/* if CAN cell has reached the Ewarning status */
  if (CAN_GetFlagStatus(CAN_SR_EWARN))
  {
    /* Error handling*/
  }
  else
  {
    /*continue */
  }
  ...
}
```

CAN_GetTransmitErrorCounter

Function Name	CAN_GetTransmitErrorCounter
Prototype	`u32 CAN_GetTransmitErrorCounter( void );`
Behavior Description	Returns the transmit error counter content
Input Parameter	None
Output Parameter	None
Return Value	Transmit Error Counter value
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to read the CAN transmit error counter.

```
{
  ...
/* raed the transmit error counter */
  if (CAN_GetTransmitErrorCounter() > 10)
  {
    /* Error handling */
  }
...
}
```

CAN_GetReceiveErrorCounter

Function Name	CAN_GetReceiveErrorCounter
Prototype	`u32 CAN_GetReceiveErrorCounter( void );`
Behavior Description	Returns the receive error counter content
Input Parameter	None
Output Parameter	None
Return Value	Receive Error Counter value
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to read the CAN receive error counter.

```
{
  ...
/* raed the receive error counter */
  if (CAN_GetReceiveErrorCounter() > 20)
  {
    /* Error handling*/
  }
...
}
```

3.14 12-bit analog-to-digital converter (ADC12)

The *ADC12* driver may be used to manage the *ADC12* in its two modes of conversion: single or round-robin and to generate a maskable interrupt when a sample is ready.

The first section describes the data structures used in the *ADC12* firmware library. The second one presents the firmware library functions.

3.14.1 Data structures

ADC12 register structure

the *ADC12* peripheral registers' structure *ADC12_TypeDef* is defined in the *71x_map.h* file as follows:

```
typedef struct
{
  vu16 DATA0;
u16 EMPTY1[3];
  vu16 DATA1;
u16 EMPTY2[3];
  vu16 DATA2;
u16 EMPTY3[3];
  vu16 DATA3;
u16 EMPTY4[3];
  vu16 CSR;
```

```
u16 EMPTY5[7];
  vu16 CPR;
u16 EMPTY6;
} ADC12_TypeDef;
```

Table 90 presents the *ADC12* registers.

Table 90. ADC12 registers

Register	Description
DATA0	ADC12 data register for Channel 0
DATA1	ADC12 data register for Channel 1
DATA2	ADC12 data register for Channel 2
DATA3	ADC12 data register for Channel 3
CSR	ADC12 control status register
CPR	ADC12 prescaler register

The *ADC12* peripheral is declared in the same file:

```
...
#define APB2_BASE 0xE0000000
...
#define ADC12_BASE      (APB2_BASE + 0x7000)
...
#ifndef DEBUG
  ...
#ifdef _ADC12
  #define ADC12         ((ADC12_TypeDef *)ADC12_BASE)
#endif /*ADC12*/
...
#else /* DEBUG */
  ...
#ifdef _ADC12
    EXT ADC12_TypeDef   *ADC12;
#endif
  ...
#endif
```

When debug mode is used, *ADC12* pointer is initialized in *71x_lib.c* file:

```
void debug(void)
{
...
#ifdef _ADC12
   ADC12 = (ADC12_TypeDef *)ADC12_BASE;
 #endif /* _ADC12 */
...
}
```

In debug mode, *_ADC12* must be defined, in *71x_conf.h* file, to access the peripheral registers as follows:

```
#define _ADC12
```

When *RCCU* functions are called, *_RCCU* must be defined, in *71x_conf.h* file, to make the *RCCU* functions accessible:

```
#define _RCCU
```

The ADC12 function accede to the Bootconf Register defined in the PCU structure, *_PCU* must be defined, in *71x_conf.h* file, to make the *PCU* register accessible:

```
#define _PCU
```

Modes of conversion

The following enumeration defines the modes of conversion. *ADC12_Modes* enumeration is defined in the file *71x_adc12.h*:

```
typedef enum
{
  ADC12_SINGLE,
  ADC12_ROUND
} ADC12_Modes;
```

Table 91 presents the *ADC12* conversion modes.

Table 91. ADC12 conversion modes

Type	Description
ADC12_SINGLE	Enables the single channel mode of conversion
ADC12_ROUND	Enables the round robin (multi-channel) mode of conversion

ADC12 channels

The following enumeration defines the *ADC12* channels. *ADC12_Channels* enumeration is defined in the file *71x_adc12.h* as follows:

```
typedef enum
{
  ADC12_CHANNEL0 = 0x00,
  ADC12_CHANNEL1 = 0x10,
  ADC12_CHANNEL2 = 0x20,
  ADC12_CHANNEL3 = 0x30
} ADC12_Channels;
```

Table 92 defines the ADC12 channels.

Table 92. ADC12 channels

ADC12 Channels	Description
ADC12_CHANNEL0	Channel 0.
ADC12_CHANNEL1	Channel 1.
ADC12_CHANNEL2	Channel 2.
ADC12_CHANNEL3	Channel 3.

ADC12 flags

The following enumeration defines the *ADC12* flags. *ADC12_Flags* enumeration is defined in the file *71x_adc12.h*:

```
typedef enum
{
  ADC12_DA0 = 0x01,
  ADC12_DA1 = 0x02,
  ADC12_DA2 = 0x04,
  ADC12_DA3 = 0x08,
  ADC12_OR  = 0x2000
} ADC12_Flags;
```

Table 93 presents the *ADC12* flags.

Table 93. ADC12 flags

ADC12 Flags	Description
ADC12_DA0	Data available in Channel 0.
ADC12_DA1	Data available in Channel 1.
ADC12_DA2	Data available in Channel 2.
ADC12_DA3	Data available in Channel 3.
ADC12_OR	Overrun: specifies whether data on one of the channels has been overwritten before being read.

3.14.2 Firmware library functions

Table 94 enumerates the different functions of the *ADC12* library.

Table 94. ADC12 library functions

Function Name	Description
ADC12_Init	Initializes the *ADC12*.
ADC12_ModeConfig	Configures the conversion mode (single channel or round robin operation).
ADC12_PrescalerConfig	Configures the prescaler to define an oversampling frequency.
ADC12_ChannelSelect	Selects the channel to be converted in single channel operation.
ADC12_ConversionStart	Starts the *ADC12* conversion in the selected mode.
ADC12_ConversionStop	Stops the *ADC12* conversion.
ADC12_ConversionValue	Gets the result of conversion from the selected data register.
ADC12_FlagStatus	Returns the status of the specified flag.
ADC12_ITConfig	Enables /Disables the *ADC12* interrupt.

ADC12_Init

Function Name	ADC12_Init
Function Prototype	`void ADC12_Init(void)`
Behavior Description	This routine is used to initialize the ADC12 registers to their reset values.
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example shows how to initialize the *ADC12*:

```
{
  /* Initialize the converter registers */
  ADC12_Init();
  ...
}
```

ADC12_ModeConfig

Function Name	ADC12_ModeConfig
Function Prototype	`void ADC12_ModeConfig (ADC12_Modes Mode);`
Behavior Description	This routine is used to select the mode of conversion.
Input Parameter	*Mode*: specifies the conversion mode. Refer to *Modes of conversion on page 215* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example shows how to configure the mode of conversion:

```
{
  ...
  /* Enable single channel mode of conversion */
  ADC12_ModeConfig(ADC12_SINGLE);
  ...
}
```

ADC12_PrescalerConfig

Function Name	ADC12_PrescalerConfig
Function Prototype	`void ADC12_PrescalerConfig(u32 Adc12_clk);`
Behavior Description	This function is used to configure the ADC sampling frequency by setting the prescaler register.
Input Parameter	*Adc12_clk*: specifies the ADC12 sampling frequency (Hz).
Output Parameter	None
Return Value	None
Required preconditions	Call of the *RCCU* library to get the *APB2* frequency
Called Functions	*RCCU_FrequencyValue on page 43*

Example:

This example shows how to configure the prescaler.

```
{
  ...
  /* Configure the ADC sampling frequency to 500Hz*/
  ADC12_PrescalerConfig(500);
  ...
}
```

ADC12_ChannelSelect

Function Name	ADC12_ChannelSelect
Function Prototype	`void ADC12_ChannelSelect(ADC_Channels ADC12_Channel);`
Behavior Description	This function selects the channel to be converted in single channel mode of conversion.
Input Parameter	*ADC12_Channel*: specifies the channel to be converted. Refer to *ADC12 channels on page 215* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	Called only if the mode of conversion selected is the single Channel mode
Called Functions	None
See also	*ADC12_ModeConfig on page 217*

Example:

This example shows how and when to use the *ADC12_ChannelSelect* function:

```
/* configure the single channel mode */
ADC12_ModeConfig(ADC12_SINGLE);
/* select the channel 3 to be converted */
ADC12_ChannelSelect(ADC12_CHANNEL3);
```

ADC12_ConversionStart

Function Name	ADC12_ConversionStart
Function Prototype	`void ADC12_ConversionStart (void);`
Behavior Description	This routine is used to launch the conversion.
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	Mode of conversion and prescaler configured
Called Functions	None
See also	*ADC12_ConversionStop on page 219*

Example:

This example shows how to start the *ADC12* conversion.

```
{
  ...
/ * configure the prescaler */
  ADC12_PrescalerConfig();
/* configure the mode */
  ADC12_ModeConfig(ADC12_SINGLE);
  /* select the channel 3 to be converted */
  ADC12_ChannelSelect(ADC12_CHANNEL3);
/* Enable the ADC12 and Start the conversion */
  ADC12_ConversionStart();
  ...
}
```

ADC12_ConversionStop

Function Name	ADC12_ConversionStop
Function Prototype	`void ADC12_ConversionStop (void);`
Behavior Description	This routine is used to disable the ADC12 cell.
Input Parameter	None
Output Parameter	None
Return Value	None
Required preconditions	Conversion started
Called Functions	None
See also	*ADC12_ConversionStart on page 219*

Example:

This example shows how to end the *ADC12* conversion.

```
{
  ...
  /* start the conversion */
```

```
  ADC12_ConversionStart();
  ...
  /* Stop the conversion */
  ADC12_ConversionStop();
  ...
}
```

ADC12_ConversionValue

Function Name	ADC12_ConversionValue
Function Prototype	`u16 ADC12_ConversionValue( ADC12_Channels ADC12_Channel);`
Behavior Description	This functions gets the conversion result from the data register of the specified channel. It returns the value of the corresponding data register.
Input Parameter	*ADC12_Channel*: specifies the channel to get its result of conversion. Refer to *ADC12 channels on page 215* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	The result of conversion of the specified channel.
Required preconditions	The conversion of the selected channel was finished and no overrun detected.
Called Functions	None
See also	*ADC12_FlagStatus on page 221*

Example:

This example shows how to get the result of conversion. It tests whether the end of conversion has been reached or not.

```
{
  u16 data;
  /* Test if the conversion of the channel 3 has finished */
  while ((ADC12_FlagStatus (ADC12_DA3)) == RESET);
  /* Test the overrun bit */
  if (ADC12_FlagStatus(ADC12_OR) == RESET)
    /* Get the conversion result */
    data = ADC12_ConversionValue(ADC12_CHANNEL3);
  ADC12_ConversionStop();
}
```

ADC12_FlagStatus

Function Name	ADC12_FlagStatus
Function Prototype	`FlagStatus ADC12_FlagStatus(ADC12_Flags flag);`
Behavior Description	This function is used to test the status of the specified flag.
Input Parameter	*flag*: specifies the flag to get the status. Refer to *ADC12 flags on page 216* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	The status of the specified flag. Its value can be: – *SET*: The corresponding Flag is Set – *RESET*: The corresponding Flag is cleared
Required preconditions	Conversion started.
Called Functions	None
See also	*ADC12_ConversionValue on page 220*

Example:

This example illustrates an example of use of the *ADC12_flagStatus* function:

```
{
  u16 test;
  ...
  /* Test if the conversion on the Channel 3 has finished or not.
*/
  while ((ADC12_FlagStatus(ADC12_DA3)) == RESET);
  /* Test the overrun bit */
  if (ADC12_FlagStatus(ADC12_OR) == RESET)
    /* Get the conversion result */
    test = ADC12_ConversionValue(3);
}
```

ADC12_ITConfig

Function Name	ADC12_ITConfig
Function Prototype	`void ADC12_ITConfig (FunctionalState NewState);`
Behavior Description	This routine is used to enable or disable the interrupt routine.
Input Parameter	*NewState*: specifies whether the interrupt will be enabled or disabled. – *ENABLE*: enable the interrupt routine. – *DISABLE*: disable the interrupt routine.
Output Parameter	None
Return Value	None
Required preconditions	The modes of conversion and the channel to be converted must be configured.
Called Functions	None

Note: ADC12_ITConfig enables or disables either one channel interrupt or all the channels. If the mode of conversion is the single mode, only the interrupt of the channel whose conversion has been activated can be enabled or disabled. In the case of the round-robin mode of conversion, all the channels' interrupts can be either enabled or disabled together.

Example:

```
{
  ...
  /* Enable interrupt */
  ADC12_ITConfig(ENABLE);
  ...
ADC12_ITConfig(DISABLE);
...
}
```

3.15 External memory interface (EMI)

The *EMI* driver may be used to access any memory bank external to the chip, via the *EMI* interface.

The first section describes the data structure used in the *EMI* firmware library. The second section presents the *EMI* firmware library functions.

3.15.1 Data structures

EMI peripheral is declared in the *71x_map.h* file as follows:

```
#define EXTMEM_BASE     0x60000000
#define EMI_BASE        (EXTMEM_BASE + 0x0C000000)
#ifndef DEBUG
...
#ifdef _EMI
  #define EMI                ((EMI_TypeDef *)EMI_BASE)
#endif /*EMI*/
```

```
...
#else  /* DEBUG */
...
#ifdef _EMI
    EXT EMI_TypeDef           *EMI;
#endif /*EMI*/
...
#endif
```

EMI Banks

The following definitions are used to specify which *EMI* bank is *to be used:*

```
#define EMI_BANK0 0x00
#define EMI_BANK1 0x01
#define EMI_BANK2 0x02
#define EMI_BANK3 0x03
```

EMI bus size

The following definitions defines the *EMI* data bus size.

```
#define  EMI_SIZE_8     0x0000
#define  EMI_SIZE_16    0x0001
```

Table 95 describes the *EMI* modes.

Table 95. EMI modes

Pin mode	Description
EMI_SIZE_8	Configures the *EMI* to work in 8-bit data bus
EMI_SIZE_16	Configures the *EMI* to work in 16-bit data bus

EMI enable

The following definition is used to enable the *EMI:*

```
#define EMI_ENABLE         0x8000
```

EMI number of wait states

The following definitions are used to configure the number of the *EMI wait states:*

```
#define EMI_0_WaitState      0x00
#define EMI_1_WaitState      0x01
#define EMI_2_WaitStates     0x02
#define EMI_3_WaitStates     0x03
#define EMI_4_WaitStates     0x04
#define EMI_5_WaitStates     0x05
#define EMI_6_WaitStates     0x06
#define EMI_7_WaitStates     0x07
#define EMI_8_WaitStates     0x08
#define EMI_9_WaitStates     0x09
#define EMI_10_WaitStates    0x0A
#define EMI_11_WaitStates    0x0B
#define EMI_12_WaitStates    0x0C
#define EMI_13_WaitStates    0x0D
#define EMI_14_WaitStates    0x0E
#define EMI_15_WaitStates    0x0F
```

3.15.2 Firmware library functions

Table 96 enumerates the different functions of the *EMI* library.

Table 96. EMI library functions

Function Name	Description
EMI_Config	Configures the *EMI* peripheral
EMI_Enable	Enables or disables the EMI peripheral

EMI_Config

Function Name	EMI_Config
Function Prototype	`void EMI_Config (u8 Bank_n, u16 B_SIZE, u16 C_LENGTH);`
Behavior Description	This routine is used, for each bank, to configure cycle length and bus size.
Input Parameter 1	*Bank_n*: selects the bank to be configured Refer to *Data structures on page 222* for more details on the allowed values of this parameter.
Input Parameter 2	*B_SIZE*: specifies the effective external bus size for an access to Bank n. Refer to *Data structures on page 222* for more details on the allowed values of this parameter.
Input Parameter 3	*C_LENGTH*: specifies the number of wait states to be inserted in any read/write cycle performed in Bank n. Refer to *Data structures on page 222* for more details on the allowed values of this parameter.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

EMI_Enable

Function Name	EMI_Enable
Function Prototype	`void EMI_Enable (u8 Bank_n, FunctionalState NewState);`
Behavior Description	This routine is used, for each bank, to configure cycle length and bus size.
Input Parameter 1	*Bank_n*: selects the bank to be enabled or disabled. Refer to *Data structures on page 222* for more details on the allowed values of this parameter.
Input Parameter 2	*NewState*: specifies wether the EMI bank will be enabled or disabled. – ENABLE: enable the specified EMI bank. – DISABLE: disable the specified EMI bank.
Output Parameter	None
Return Value	None
Required preconditions	None
Called Functions	None

Example:

This example illustrates how to configure the *EMI*.

```
{
  u8 data;
  ...
     /* Configure the EMI bank 1: 7 wait states, 16-bit wide
external memory device */
  EMI_Config(EMI_BANK1, EMI_SIZE_16 ,EMI_7_WaitStates)
/* Enable EMI bank 1 */
EMI_Enable (EMI_BANK1, ENABLE);
  /* Write data to the external memory */
  *(u32*)0x62000000 = 0x12345678; /* write 12345678 in bank 1 */
  /* Read data from the external memory */
  data = *(u8*)0x62000008; /* read from bank 1 */
  ...
}
```

4 Revision history

Table 97. Document revision history

Date	Revision	Changes
24-Jan-2006	1.0	Initial release.
31-Jan-04	1.1	Changed file description in *Section 2.1 on page 11*, below figure 1. Changed RCCU_RCLK_Clocks enum type in *RCLK clock source on page 31*. Added RCCU_RTC_CLOCK row in *RCLK clock source on page 31*.
27-Mar-04	1.2	Added Register name differences Section 3
10-Jul-04	1.3	New types are defined in *Section 1.4 on page 7* How to use the STR71x Library in *Section 2.3 on page 14* PCU_EnterWFI function renamed to PCU_WFIEnter in Section 5.1.2.7 PCU_EnterLPM function renamed to PCU_LPMEnter in Section 5.1.2.8 FLASH_AccessPrConfig function deleted in *Section 3.16 on page 241* FLASH_EraseSector function renamed to FLASH_SectorErase in *Section on page 248* FLASH_EraseBank function renamed to FLASH_BankErase in *FLASH_BankErase on page 249* FLASH_EraseModule renamed to FLASH_ModuleErase in Section 5.16.2.8 New Function RCCU_ResetSources added in *RCCU_ResetSource on page 45*
31-Mar-05	2.0	Package Description *Section 2.1 on page 11* How to use the STR71x Library *Section 2.3 on page 14* STR71xDL7 renamed to 71xLibraryD *Section 3.3.1 on page 18* STR71xnDL renamed to 71xLibraryR.lib *Section 3.3.1 on page 18* newDL.prj & newnDL.prj renamed to debug.prj & release.prj *Section 3.3.1 on page 18* New Enumerations PLL1 Multiplication factors and PLL2 Multiplication factors *Section 3.2 on page 29* RCCU_PLL1Config & RCCU_PLL2Config prototype modified *Section 3.2 on page 29* RTC_SetTime & RTC_SetAlarmTime functions deleted (see AN 1780) *Section 3.7 on page 84* FLASH_BlockWrite: deleted *Section 3.16 on page 241* FLASH_BlockRead: deleted *Section 3.16 on page 241* TIM_CounterConfig function behaviour description modified *TIM_CounterConfig on page 118* TIM_CounterValue function added *TIM_CounterValue on page 118* ADC12_PrescalerConfig equation corrected *ADC12_PrescalerConfig on page 218*

Table 97. Document revision history (continued)

Date	Revision	Changes
17-Sep-07	3	Changed document title to STR71x firmware library. Added *List of tables*. Removed Flash and USB sections. Removed *Section 4.16.1: Write Operation States*. Section 2: “Environment overview” removed *Section 2.1: Package description on page 11* updated System file list updated in *Section 2.2 on page 12* Modified *Section 3.1: Power control unit (PCU)* Example code updated for *WFI clocks on page 19* Description table updated for *WFI clocks on page 19* Low power modes section removed. Renamed the following file names: ppp.c by 71x_ppp.c, ppp.h by 71x_ppp.h, adc12.h by 71x_adc12.h, pcu.h by 71x_pcu.h, rccu.h by 71x_rccu.h, emi.h by 71x_emi.h, apb.h by 71x_apb.h, bspi.h by 71x_bspi.h, can.h by 71x_can.h, gpio.h by 71x_gpio.h, i2c.h by 71x_i2c.h, rtc.h by 71x_rtc.h, tim.h by 71x_tim.h, uart.h by 71x_uart.h, wdg.h by 71x_wdg.h and xti.h by 71x_xti.h Removed functions *PCU_WFIEnter* and *PCU_LPMEnter*. Added functions *PCU_LPModesConfig*, *PCU_WFI*, *PCU_STOP*, *PCU_STANDBY*, *PCU_FlashBurstCmd*. In *Section 3.2: Reset and clock control unit (RCCU)* Example code updated for *RCLK clock source on page 31* New section added *PLL1 free running modes on page 35* *RCCU_PLL1FreeRunningModeConfig*, *RCCU_PLL1Disable*, *RCCU_PLL2Disable*, *PCU_32OSCCmd* added Renamed function *RCCU_PCLK* to *RCCU_PCLK2* Renamed function *RCCU_FCLK* to *RCCU_PCLK1* Renamed function *RCCU_RTC_CLOCK* to *RCCU_CK_AF* Changed function *RCCU_PCLKConfig* to *RCCU_PCLK2Config* Renamed function *RCCU_FCLKConfig* to *RCCU_PCLK1Config* Added new function *RCCU_PLL1FreeRunningModeConfig* Added new function *RCCU_PLL1Disable* Added new function *RCCU_PLL2Disable* Added new function *RCCU_GenerateSWReset* Renamed *WFI_EXTERNAL* to *WFI_Ck_AF* Modified *Section 3.9: Timer (TIM)* Description updated for *TIM_ITConfig on page 119* Input parameters corrected for *TIM_OPModeConfig on page 115* Description updated for *TIM_ITConfig on page 119* Renamed function *TIM_TOE_Mask* to *TIM_TOIE_Mask* Renamed function *TIM_OCAIE_mask* to *TIM_OCAIE_Mask* Renamed function *TIM_OCBIE_mask* to *TIM_OCBIE_Mask*

Table 97. Document revision history (continued)

Date	Revision	Changes
17-Sep-07	3 (cont'd)	In *Section 3.10: Buffered serial peripheral interface (BSPI)* Renamed the typedef *BSPI_ITS* to *BSPI_IT_ERR* Renamed the interrupt error sources: *BSPI_BERIT* by *BSPI_BEIE, BSPI_RCIT* by *BSPI_REIE and BSPI_ALL* by *BSPI_ALL_ERR* Changed typedef *BSPI_TR_IT_SRCS* to *BSPI_IT_TR* Changed typedef *BSPI_RC_IR_SRCS* to *BSPI_IT_RC* Changed *BSPI_ItEnable* function name to *BSPI_ErrItSrc* Added new function *BSPI_WordBufferSend* Added new function *BSPI_WordBufferReceive*, Changed *BSPI_BufferSend* function to *BSPI_ByteBufferSend* Changed *BSPI_BufferReceive* function to *BSPI_ByteBufferReceive* In *Section 3.11: Universal asynchronous receiver transmitter (UART)* Changed *UART_RxBufFull* to *UART_RxBufNotEmpty* Changed *sendchar* function name to *SendChar* In *Section 3.12: Inter-integrated circuit (I2C)* I^2C Flags updated, *I2C flags on page 167* I2C_FlagStatus example modified, *I2C_FlagStatus on page 176* Note 2 added for *GPIO_BitWrite* and *GPIO_ByteWrite* tables Repeated I2C registers table deleted: *Section 3.12.1 on page 165* I2C_StringSend, I2C_BufferSend, I2C_BufferReceive removed Added new functions *I2C_GetLastEvent* and *I2C_CheckEvent*. Added *Section : I2C events on page 169*. In *Section 3.13: Controller area network (CAN)* Preconditions updated for *CAN_SetBitrate on page 196* Preconditions updated for *CAN_Init on page 202* Changed *CAN_InvalidateAllMsgObj* function name to *CAN_SetUnusedAllMsgObj* Changed *CAN_IsMessageWaiting* function name to *CAN_GetMsgReceiveStatus* Changed *CAN_IsTransmitRequested* function name to *CAN_GetMsgTransmitRequestStatus* Changed *CAN_IsObjectValid* function name to *CAN_GetMsgValidStatus* Changed *CAN_IsInterruptPending* function name to *CAN_GetMsgInterruptStatus* Added new function *CAN_UpdateMsgObj* Added new function *CAN_TransmitRequest* Added new function *CAN_GetFlagStatus* Added new function *CAN_GetTransmitErrorCounter* Added new function *CAN_GetReceiveErrorCounter* In *Section 3.15: External memory interface (EMI)* Modified *EMI_Config on page 224* Modified the define values in *EMI Banks on page 223* Added a new function *EMI_Enable on page 225*

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