# GRIGORA

1.0.0

Generated by Doxygen 1.9.1

# 1 Todo List

**File EXTI.c**

Debug configuration of INT4 to INT7 as edge triggered not working.

# 2 Data Structure Index

## 2.1 Data Structures

Here are the data structures with brief descriptions:

# 3 File Index

## 3.1 File List

Here is a list of all files with brief descriptions:

# 4 Data Structure Documentation

## 4.1 BatteryConfigs_t Struct Reference

`#include <BATTERY_cfg.h>`

### Data Fields

- PIN_t pin
- PORT_t port
- f32 minVoltage
- f32 maxVoltage

### 4.1.1 Detailed Description

Definition at line 21 of file BATTERY_cfg.h.

### 4.1.2 Field Documentation

#### 4.1.2.1 maxVoltage `f32 maxVoltage`

Definition at line 25 of file BATTERY_cfg.h.

#### 4.1.2.2 minVoltage `f32 minVoltage`

Definition at line 24 of file BATTERY_cfg.h.

#### 4.1.2.3 pin `PIN_t pin`

Definition at line 22 of file BATTERY_cfg.h.

#### 4.1.2.4 port `PORT_t port`

Definition at line 23 of file BATTERY_cfg.h.

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

- code/include/BATTERY_cfg.h

## 4.2 BUTTON_CONFIGS_t Struct Reference

`#include <BUTTON_cfg.h>`

### Data Fields

- BUTTON_t button
- PIN_t pin
- PORT_t port
- ACTIVATION_STATUS_t ActiveHighOrLow
- DEBOUNCE_t debounceStatus

### 4.2.1 Detailed Description

Definition at line 17 of file BUTTON_cfg.h.

### 4.2.2 Field Documentation

#### 4.2.2.1 ActiveHighOrLow `ACTIVATION_STATUS_t ActiveHighOrLow`

Definition at line 21 of file BUTTON_cfg.h.

#### 4.2.2.2 button BUTTON_t button

Definition at line 18 of file BUTTON_cfg.h.

#### 4.2.2.3 debounceStatus DEBOUNCE_t debounceStatus

Definition at line 22 of file BUTTON_cfg.h.

#### 4.2.2.4 pin PIN_t pin

Definition at line 19 of file BUTTON_cfg.h.

#### 4.2.2.5 port PORT_t port

Definition at line 20 of file BUTTON_cfg.h.

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

- code/include/BUTTON_cfg.h

## 4.3 CONNECTIONS_t Struct Reference

```
#include <NRF24_cfg.h>
```

### Data Fields

- PIN_t pin
- PORT_t port

### 4.3.1 Detailed Description

Definition at line 12 of file NRF24_cfg.h.

### 4.3.2 Field Documentation

#### 4.3.2.1 pin PIN_t pin

Definition at line 13 of file NRF24_cfg.h.

#### 4.3.2.2 port PORT_t port

Definition at line 14 of file NRF24_cfg.h.

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

- code/include/NRF24_cfg.h

## 4.4 IR_CONFIG_t Struct Reference

`#include <IR_cfg.h>`

### Data Fields

- IR_SENSOR_t sensor
- PIN_t pin
- PORT_t port
- ACTIVATION_STATUS_t ActiveHighOrLow

### 4.4.1 Detailed Description

Definition at line 12 of file IR_cfg.h.

### 4.4.2 Field Documentation

#### 4.4.2.1 ActiveHighOrLow ACTIVATION_STATUS_t ActiveHighOrLow

Definition at line 16 of file IR_cfg.h.

#### 4.4.2.2 pin PIN_t pin

Definition at line 14 of file IR_cfg.h.

#### 4.4.2.3 port PORT_t port

Definition at line 15 of file IR_cfg.h.

#### 4.4.2.4 sensor IR_SENSOR_t sensor

Definition at line 13 of file IR_cfg.h.

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

- code/include/IR_cfg.h

## 4.5 LED_CONFIGS_t Struct Reference

`#include <LED_cfg.h>`

### Data Fields

- LED_t led
- PIN_t pin
- PORT_t port

### 4.5.1 Detailed Description

Definition at line 12 of file LED_cfg.h.

### 4.5.2 Field Documentation

#### 4.5.2.1 led LED_t led

Definition at line 13 of file LED_cfg.h.

#### 4.5.2.2 pin PIN_t pin

Definition at line 14 of file LED_cfg.h.

#### 4.5.2.3 port PORT_t port

Definition at line 15 of file LED_cfg.h.

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

- code/include/LED_cfg.h

## 4.6 LIFTER_CONFIGS_t Struct Reference

`#include <LIFTER_cfg.h>`

### Data Fields

- PIN_t directionPin
- PORT_t directionPinPort
- PIN_t pulsePin
- PORT_t pulsePinPort
- PIN_t enablePin
- PORT_t enablePinPort
- u8 overallStroke
- u16 pulsesPerRevolution
- u8 revolutionStroke
- u8 speed

### 4.6.1 Detailed Description

Definition at line 25 of file LIFTER_cfg.h.

### 4.6.2 Field Documentation

#### 4.6.2.1 directionPin `PIN_t directionPin`

Definition at line 26 of file LIFTER_cfg.h.

#### 4.6.2.2 directionPinPort `PORT_t directionPinPort`

Definition at line 27 of file LIFTER_cfg.h.

#### 4.6.2.3 enablePin `PIN_t enablePin`

Definition at line 30 of file LIFTER_cfg.h.

#### 4.6.2.4 enablePinPort `PORT_t enablePinPort`

Definition at line 31 of file LIFTER_cfg.h.

#### 4.6.2.5 overallStroke `u8 overallStroke`

Definition at line 32 of file LIFTER_cfg.h.

#### 4.6.2.6 pulsePin `PIN_t pulsePin`

Definition at line 28 of file LIFTER_cfg.h.

#### 4.6.2.7 pulsePinPort `PORT_t pulsePinPort`

Definition at line 29 of file LIFTER_cfg.h.

#### 4.6.2.8 pulsesPerRevolution `u16 pulsesPerRevolution`

Definition at line 33 of file LIFTER_cfg.h.

#### 4.6.2.9 revolutionStroke `u8 revolutionStroke`

Definition at line 34 of file LIFTER_cfg.h.

#### 4.6.2.10 speed `u8 speed`

Definition at line 35 of file LIFTER_cfg.h.

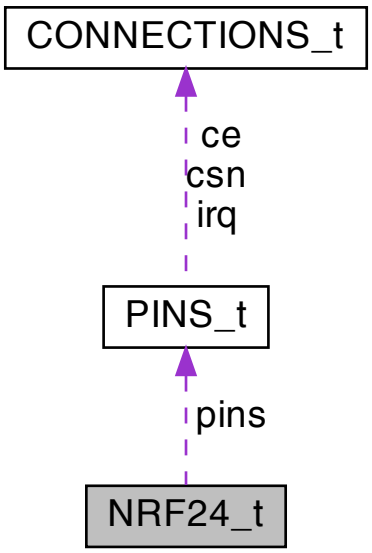
The documentation for this struct was generated from the following file:

- code/include/LIFTER_cfg.h

## 4.7 NRF24_t Struct Reference

`#include <NRF24_cfg.h>`

Collaboration diagram for NRF24_t:




### Data Fields

- PINS_t pins
- u8 channel
- u8 payload_len
- u8 addressWidth
- u8 txAddress [5]
- u8 txPayload [32]
- u8 rx0Address [5]
- u8 rx0Payload [32]
- u8 rx1Address [5]
- u8 rx1Payload [32]
- u8 rx2Address [5]
- u8 rx2Payload [32]
- u8 rx3Address [5]
- u8 rx3Payload [32]
- u8 rx4Address [5]
- u8 rx4Payload [32]
- u8 rx5Address [5]
- u8 rx5Payload [32]
- PIPE_t rxPipe

### 4.7.1 Detailed Description

Definition at line 32 of file NRF24_cfg.h.

### 4.7.2 Field Documentation

#### 4.7.2.1 addressWidth `u8 addressWidth`

Definition at line 36 of file NRF24_cfg.h.

#### 4.7.2.2 channel `u8 channel`

Definition at line 34 of file NRF24_cfg.h.

#### 4.7.2.3 payload_len `u8 payload_len`

Definition at line 35 of file NRF24_cfg.h.

#### 4.7.2.4 pins `PINS_t pins`

Definition at line 33 of file NRF24_cfg.h.

#### 4.7.2.5 rx0Address `u8 rx0Address[5]`

Definition at line 39 of file NRF24_cfg.h.

#### 4.7.2.6 rx0Payload `u8 rx0Payload[32]`

Definition at line 40 of file NRF24_cfg.h.

#### 4.7.2.7 rx1Address `u8 rx1Address[5]`

Definition at line 41 of file NRF24_cfg.h.

#### 4.7.2.8 rx1Payload u8 rx1Payload[32]

Definition at line 42 of file NRF24_cfg.h.

#### 4.7.2.9 rx2Address u8 rx2Address[5]

Definition at line 43 of file NRF24_cfg.h.

#### 4.7.2.10 rx2Payload u8 rx2Payload[32]

Definition at line 44 of file NRF24_cfg.h.

#### 4.7.2.11 rx3Address u8 rx3Address[5]

Definition at line 45 of file NRF24_cfg.h.

#### 4.7.2.12 rx3Payload u8 rx3Payload[32]

Definition at line 46 of file NRF24_cfg.h.

#### 4.7.2.13 rx4Address u8 rx4Address[5]

Definition at line 47 of file NRF24_cfg.h.

#### 4.7.2.14 rx4Payload u8 rx4Payload[32]

Definition at line 48 of file NRF24_cfg.h.

#### 4.7.2.15 rx5Address u8 rx5Address[5]

Definition at line 49 of file NRF24_cfg.h.

#### 4.7.2.16 rx5Payload u8 rx5Payload[32]

Definition at line 50 of file NRF24_cfg.h.

#### 4.7.2.17 rxPipe PIPE_t rxPipe

Definition at line 51 of file NRF24_cfg.h.

#### 4.7.2.18 txAddress u8 txAddress[5]

Definition at line 37 of file NRF24_cfg.h.

#### 4.7.2.19 txPayload u8 txPayload[32]

Definition at line 38 of file NRF24_cfg.h.

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

- code/include/NRF24_cfg.h

## 4.8 ORDER_INFO_t Struct Reference

Information of an order.

`#include <app.h>`

### Data Fields

- ORDER_AVAILABILITY_t recievedOrNot
- COLUMN_t column
- ROW_t row
- ORDER_TRACKING_t deliveryState

### 4.8.1 Detailed Description

Information of an order.

The order is composed of the following information:

- Order ID: The ID of the order.
- Availability: If the order has been received or not.
- Column: The column coordinate of the order.
- Row: The row coordinate of the order.
- Tracking state: states of the order, member of ORDER_TRACKING_t.

Definition at line 91 of file app.h.

#### 4.8.2 Field Documentation

##### 4.8.2.1 column COLUMN_t column

Definition at line 93 of file app.h.

##### 4.8.2.2 deliveryState ORDER_TRACKING_t deliveryState

Definition at line 95 of file app.h.

##### 4.8.2.3 recievedOrNot ORDER_AVAILABILITY_t recievedOrNot

Definition at line 92 of file app.h.

##### 4.8.2.4 row ROW_t row

Definition at line 94 of file app.h.

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

- code/include/app.h

### 4.9 PinConfig_t Struct Reference

`#include <DIO_cfg.h>`

#### Data Fields

- PIN_t pin
- PORT_t port
- DIR_t direction
- PULLUP_t pullup

#### 4.9.1 Detailed Description

**Note**

pins a of SSegment connected to MSB and dot point to LSB if no BCD is used

Definition at line 16 of file DIO_cfg.h.

### 4.9.2 Field Documentation

#### 4.9.2.1 direction DIR_t direction

Definition at line 19 of file DIO_cfg.h.

#### 4.9.2.2 pin PIN_t pin

Definition at line 17 of file DIO_cfg.h.

#### 4.9.2.3 port PORT_t port

Definition at line 18 of file DIO_cfg.h.

#### 4.9.2.4 pullup PULLUP_t pullup

Definition at line 20 of file DIO_cfg.h.

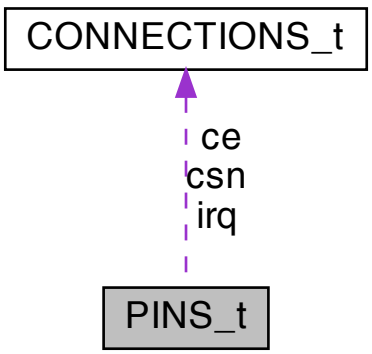
The documentation for this struct was generated from the following file:

- code/include/DIO_cfg.h

## 4.10 PINS_t Struct Reference

```
#include <NRF24_cfg.h>
```

Collaboration diagram for PINS_t:



**Data Fields**

- CONNECTIONS_t ce
- CONNECTIONS_t csn
- CONNECTIONS_t irq

### 4.10.1 Detailed Description

Definition at line 17 of file NRF24_cfg.h.

### 4.10.2 Field Documentation

#### 4.10.2.1 ce `CONNECTIONS_t ce`

Definition at line 18 of file NRF24_cfg.h.

#### 4.10.2.2 csn `CONNECTIONS_t csn`

Definition at line 19 of file NRF24_cfg.h.

#### 4.10.2.3 irq `CONNECTIONS_t irq`

Definition at line 20 of file NRF24_cfg.h.

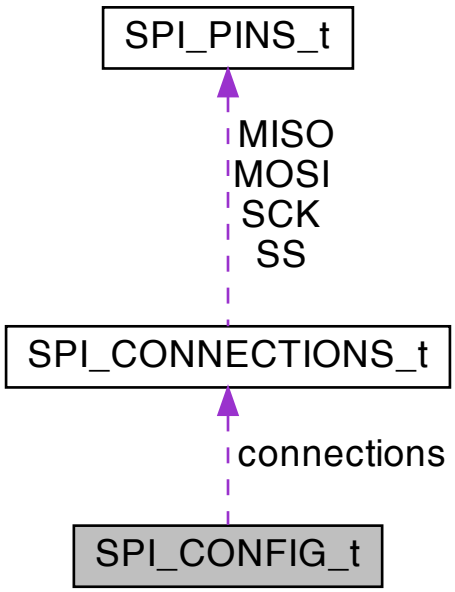
The documentation for this struct was generated from the following file:

- code/include/NRF24_cfg.h

## 4.11 SPI_CONFIG_t Struct Reference

`#include <SPI_cfg.h>`

Collaboration diagram for SPI_CONFIG_t:




### Data Fields

- SPI_CONNECTIONS_t connections
- SPI_MODE_t mode
- SPI_DATA_ORDER_t dataOrder
- SPI_CLOCK_MODE_t clockMode
- SPI_PRESCALER_t clockDivider
- SPI_DOUBLE_SPEED_t doubleSpeed

### 4.11.1 Detailed Description

Definition at line 56 of file SPI_cfg.h.

### 4.11.2 Field Documentation

#### 4.11.2.1 clockDivider SPI_PRESCALER_t clockDivider

Definition at line 61 of file SPI_cfg.h.

#### 4.11.2.2 clockMode SPI_CLOCK_MODE_t clockMode

Definition at line 60 of file SPI_cfg.h.

#### 4.11.2.3 connections SPI_CONNECTIONS_t connections

Definition at line 57 of file SPI_cfg.h.

#### 4.11.2.4 dataOrder SPI_DATA_ORDER_t dataOrder

Definition at line 59 of file SPI_cfg.h.

#### 4.11.2.5 doubleSpeed SPI_DOUBLE_SPEED_t doubleSpeed

Definition at line 62 of file SPI_cfg.h.

#### 4.11.2.6 mode SPI_MODE_t mode

Definition at line 58 of file SPI_cfg.h.

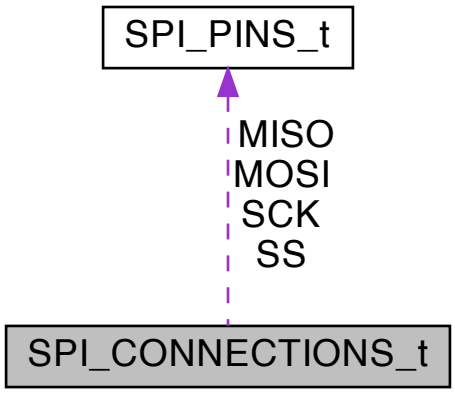
The documentation for this struct was generated from the following file:

- code/include/SPI_cfg.h

## 4.12 SPI_CONNECTIONS_t Struct Reference

`#include <SPI_cfg.h>`

Collaboration diagram for SPI_CONNECTIONS_t:




### Data Fields

- SPI_PINS_t SS
- SPI_PINS_t MOSI
- SPI_PINS_t MISO
- SPI_PINS_t SCK

### 4.12.1 Detailed Description

Definition at line 49 of file SPI_cfg.h.

### 4.12.2 Field Documentation

#### 4.12.2.1 MISO `SPI_PINS_t MISO`

Definition at line 52 of file SPI_cfg.h.

#### 4.12.2.2 MOSI `SPI_PINS_t MOSI`

Definition at line 51 of file SPI_cfg.h.

#### 4.12.2.3 SCK `SPI_PINS_t SCK`

Definition at line 53 of file SPI_cfg.h.

#### 4.12.2.4 SS `SPI_PINS_t SS`

Definition at line 50 of file SPI_cfg.h.

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

- code/include/SPI_cfg.h

## 4.13 SPI_PINS_t Struct Reference

`#include <SPI_cfg.h>`

### Data Fields

- PIN_t pin
- PORT_t port

### 4.13.1 Detailed Description

Definition at line 44 of file SPI_cfg.h.

### 4.13.2 Field Documentation

#### 4.13.2.1 pin `PIN_t pin`

Definition at line 45 of file SPI_cfg.h.

#### 4.13.2.2 port `PORT_t port`

Definition at line 46 of file SPI_cfg.h.

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

- code/include/SPI_cfg.h

## 4.14 UART_CFG_t Struct Reference

`#include <UART_cfg.h>`

### Data Fields

- const u32 baud_rate
- UART_DATA_BITS_t data_bits
- UART_STOP_BITS_t stop_bits
- UART_PARITY_t parity
- UART_MODE_t mode
- UART_MODE_TYPE_t mode_type
- UART_CLOCK_POLARITY_t clock_polarity

### 4.14.1 Detailed Description

Definition at line 54 of file UART_cfg.h.

### 4.14.2 Field Documentation

#### 4.14.2.1 baud_rate `const u32 baud_rate`

Definition at line 55 of file UART_cfg.h.

#### 4.14.2.2 clock_polarity `UART_CLOCK_POLARITY_t clock_polarity`

Definition at line 61 of file UART_cfg.h.

#### 4.14.2.3 data_bits `UART_DATA_BITS_t data_bits`

Definition at line 56 of file UART_cfg.h.

#### 4.14.2.4 mode `UART_MODE_t mode`

Definition at line 59 of file UART_cfg.h.

#### 4.14.2.5 mode_type `UART_MODE_TYPE_t mode_type`

Definition at line 60 of file UART_cfg.h.

#### 4.14.2.6 parity `UART_PARITY_t parity`

Definition at line 58 of file UART_cfg.h.

#### 4.14.2.7 stop_bits `UART_STOP_BITS_t stop_bits`

Definition at line 57 of file UART_cfg.h.

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

- code/include/UART_cfg.h

## 4.15 WHEELS_CONFIG_t Struct Reference

`#include <WHEELS_cfg.h>`

### Data Fields

- PIN_t ENA_pin
- PORT_t ENA_port
- PIN_t ENB_pin
- PORT_t ENB_port
- PWM_t IN1A_channel
- PWM_t IN2A_channel
- PWM_t IN1B_channel
- PWM_t IN2B_channel
- PIN_t CTA_pin
- PORT_t CTA_port
- PIN_t CTB_pin
- PORT_t CTB_port
- u8 currentSensitivity
- u8 SpeedPercentage
- WHEELS_POSITION_t WHEELS_Position

### 4.15.1 Detailed Description

Definition at line 12 of file WHEELS_cfg.h.

### 4.15.2 Field Documentation

#### 4.15.2.1 CTA_pin PIN_t CTA_pin

Definition at line 23 of file WHEELS_cfg.h.

#### 4.15.2.2 CTA_port PORT_t CTA_port

Definition at line 24 of file WHEELS_cfg.h.

#### 4.15.2.3 CTB_pin PIN_t CTB_pin

Definition at line 25 of file WHEELS_cfg.h.

#### 4.15.2.4 CTB_port PORT_t CTB_port

Definition at line 26 of file WHEELS_cfg.h.

#### 4.15.2.5 currentSensitivity u8 currentSensitivity

Definition at line 28 of file WHEELS_cfg.h.

#### 4.15.2.6 ENA_pin PIN_t ENA_pin

Definition at line 13 of file WHEELS_cfg.h.

#### 4.15.2.7 ENA_port PORT_t ENA_port

Definition at line 14 of file WHEELS_cfg.h.

#### 4.15.2.8 ENB_pin PIN_t ENB_pin

Definition at line 15 of file WHEELS_cfg.h.

#### 4.15.2.9 ENB_port PORT_t ENB_port

Definition at line 16 of file WHEELS_cfg.h.

#### 4.15.2.10 IN1A_channel PWM_t IN1A_channel

Definition at line 18 of file WHEELS_cfg.h.

#### 4.15.2.11 IN1B_channel PWM_t IN1B_channel

Definition at line 20 of file WHEELS_cfg.h.

#### 4.15.2.12 IN2A_channel PWM_t IN2A_channel

Definition at line 19 of file WHEELS_cfg.h.

#### 4.15.2.13 IN2B_channel PWM_t IN2B_channel

Definition at line 21 of file WHEELS_cfg.h.

#### 4.15.2.14 SpeedPercentage u8 SpeedPercentage

Definition at line 29 of file WHEELS_cfg.h.

#### 4.15.2.15 WHEELS_Position WHEELS_POSITION_t WHEELS_Position

Definition at line 30 of file WHEELS_cfg.h.

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

- code/include/WHEELS_cfg.h

# 5 File Documentation

## 5.1 code/include/app.h File Reference

Types and APIs for application app.c.

### Data Structures

- struct ORDER_INFO_t

  *Information of an order.*

### Enumerations

- enum NAVIGATION_MODE_t { AUTONOMOUS_MODE , MANUAL_MODE }

  *Navigation modes of the robot.*
- enum ROBOT_STATE_t { ROBOT_AVAILABLE , ROBOT_PROCESSING_OEDER , ROBOT_CHARGING , ROBOT_OBSTACLE_AVOIDANCE }

  *Different states of the robot.*
- enum ORDER_AVAILABILITY_t { NO_ORDER_RECIEVED , ORDER_RECIEVED }

  *Availability of new orders.*
- enum ORDER_TRACKING_t { ORDER_PROCESSING , ORDER_OUT_FOR_DELIVER , ORDER_DELIVERED , ORDER_GOING_BACK , ORDER_RETURNED }

  *Different states of the order.*
- enum CLIENT_PICKUP_t { CLIENT_PICKUP_NO , CLIENT_PICKUP_YES }

  *Pickup state of the item. If the client has picked up the item or not.*
- enum ORIENTATION_t { NORTH = 0 , EAST = 90 , SOUTH = 180 , WEST = 270 }

  *Orientation of the robot face.*

### Functions

- NAVIGATION_MODE_t checkAutoOrManualNavigation (void)
- void autonomousMode (void)
- void manualNavigation (void)
- void monitorBattery (void)
- void handleOrder (ORDER_INFO_t order)
- ORDER_INFO_t getOrderInfo (void)
- void navigate (COLUMN_t column, ROW_t row)
- void navigateColumn (COLUMN_t column)
- void navigateRow (const ROW_t row)
- void modifyOrientation (const ORIENTATION_t orientation)
- STATE_t onTrack (void)
- STATE_t onLeftSmooth (void)
- STATE_t onLeftSharp (void)
- STATE_t onRightSmooth (void)
- STATE_t onRightSharp (void)
- void gotoNextJunction (void)
- void sendPosition (const COLUMN_t column, const ROW_t row)
- BOOL_t onJunction (void)
- BOOL_t onObstacle (void)
- void sendRobotState (const ROBOT_STATE_t robotState)
- void sendOrderTrackInfo (const ORDER_TRACKING_t orderTrackInfo)
- void waitForClientPickup (void)
- STATE_t MASTER_PickItem (void)
- u8 readSerial (void)
- void avoidObstacle (void)

### 5.1.1 Detailed Description

Types and APIs for application app.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**



### 5.1.2 Enumeration Type Documentation

#### 5.1.2.1 CLIENT_PICKUP_t enum CLIENT_PICKUP_t

Pickup state of the item. If the client has picked up the item or not.

The item can be in one of the following states:

- Picked up: The item has been picked up by the client.
- Not picked up: The item has not been picked up by the client.

**Enumerator**

| | |
|---|---|
| CLIENT_PICKUP_NO | Not picked up state |
| CLIENT_PICKUP_YES | Picked up state |

Definition at line 77 of file app.h.

#### 5.1.2.2 NAVIGATION_MODE_t enum NAVIGATION_MODE_t

Navigation modes of the robot.

The robot can be in one of the following modes:

- Manual mode: The robot is controlled by the user either by the joystick or the mobile app.
- Autonomous mode: The robot moves autonomously by the sensors.

**Enumerator**

| | |
|---|---|
| AUTONOMOUS_MODE | Autonomous mode |
| MANUAL_MODE | Manual mode |

Definition at line 22 of file app.h.

#### 5.1.2.3 ORDER_AVAILABILITY_t `enum ORDER_AVAILABILITY_t`

Availability of new orders.

The order can either be:

- Received: The order has been received and is ready to be processed.
- Not received: The order has not been received yet.

**Enumerator**

| | |
|---|---|
| NO_ORDER_RECIEVED | No order received |
| ORDER_RECIEVED | Order received |

Definition at line 49 of file app.h.

#### 5.1.2.4 ORDER_TRACKING_t `enum ORDER_TRACKING_t`

Different states of the order.

The order can be in one of the following states:

- Processing: The order is being processed. The robot is on its way to the shelf to get the item.
- Out for delivery: The order is out for delivery. The robot has picked the shelf and is on its way to the client.
- Delivered: The order has been delivered to the client and is ready to be picked up.
- Going back: The client has picked the item, hence the robot will return the shelf to its original position.
- Returned: The robot has returned the shelf to its original position.

**Enumerator**

| | |
|---|---|
| ORDER_PROCESSING | Processing state |
| ORDER_OUT_FOR_DELIVER | Out for delivery state |
| ORDER_DELIVERED | Delivered state |
| ORDER_GOING_BACK | Going back state |
| ORDER_RETURNED | Returned state |

Definition at line 63 of file app.h.

#### 5.1.2.5 ORIENTATION_t `enum ORIENTATION_t`

Orientation of the robot face.

The robot can be in one of the following orientations:

- North: The robot is facing north.
- East: The robot is facing east.
- South: The robot is facing south.
- West: The robot is facing west.

**Enumerator**

| | |
|---|---|
| NORTH | |
| EAST | |
| SOUTH | |
| WEST | |

Definition at line 106 of file app.h.

#### 5.1.2.6 ROBOT_STATE_t `enum ROBOT_STATE_t`

Different states of the robot.

The robot can be in one of the following states:

- Available: The robot is available to receive commands.
- Processing: The robot is processing a command (e.g. processing an order to get an item). It is not available to receive commands until the current command is completed.
- Charging: The robot is charging. It is not available to receive commands until the charging is completed.
- Obstacle: The robot is in an obstacle. It is not available to receive commands until the obstacle is removed.

**Enumerator**

| | |
|---|---|
| ROBOT_AVAILABLE | Available state |
| ROBOT_PROCESSING_OEDER | Processing state |
| ROBOT_CHARGING | Charging state |
| ROBOT_OBSTACLE_AVOIDANCE | Obstacle state |

Definition at line 36 of file app.h.

### 5.1.3 Function Documentation

#### 5.1.3.1 autonomousMode() `void autonomousMode (`

`void )`

#### 5.1.3.2 avoidObstacle() `void avoidObstacle (`

`void )`

#### 5.1.3.3 checkAutoOrManualNavigation() `NAVIGATION_MODE_t checkAutoOrManualNavigation (`

`void )`

#### 5.1.3.4 getOrderInfo() `ORDER_INFO_t getOrderInfo (`

`void )`

#### 5.1.3.5 gotoNextJunction() `void gotoNextJunction (`

`void )`

#### 5.1.3.6 handleOrder() `void handleOrder (`

`ORDER_INFO_t` *order* )

#### 5.1.3.7 manualNavigation()

```
void manualNavigation (
        void  )
```

#### 5.1.3.8 MASTER_PickItem()

```
STATE_t MASTER_PickItem (
        void  )
```

#### 5.1.3.9 modifyOrientation()

```
void modifyOrientation (
        const ORIENTATION_t orientation )
```

#### 5.1.3.10 monitorBattery()

```
void monitorBattery (
        void  )
```

#### 5.1.3.11 navigate()

```
void navigate (
        COLUMN_t column,
        ROW_t row )
```

#### 5.1.3.12 navigateColumn()

```
void navigateColumn (
        COLUMN_t column )
```

#### 5.1.3.13 navigateRow()

```
void navigateRow (
        const ROW_t row )
```

#### 5.1.3.14 onJunction()

```
BOOL_t onJunction (
        void  )
```

#### 5.1.3.15 onLeftSharp()

```
STATE_t onLeftSharp (
        void  )
```

#### 5.1.3.16 onLeftSmooth()

```
STATE_t onLeftSmooth (
    void )
```

#### 5.1.3.17 onObstacle()

```
BOOL_t onObstacle (
    void )
```

#### 5.1.3.18 onRightSharp()

```
STATE_t onRightSharp (
    void )
```

#### 5.1.3.19 onRightSmooth()

```
STATE_t onRightSmooth (
    void )
```

#### 5.1.3.20 onTrack()

```
STATE_t onTrack (
    void )
```

#### 5.1.3.21 readSerial()

```
u8 readSerial (
    void )
```

#### 5.1.3.22 sendOrderTrackInfo()

```
void sendOrderTrackInfo (
    const ORDER_TRACKING_t orderTrackInfo )
```

#### 5.1.3.23 sendPosition()

```
void sendPosition (
    const COLUMN_t column,
    const ROW_t row )
```

#### 5.1.3.24 sendRobotState()

```
void sendRobotState (
    const ROBOT_STATE_t robotState )
```

#### 5.1.3.25 waitForClientPickup()

```
void waitForClientPickup (
    void )
```

## 5.2 code/include/app_cfg.h File Reference

Configuration header file for app.c.

### Macros

- #define NAVIGATION_MODE_BUTTON BUTTON_0
- #define ITEM_PICKUP_BUTTON BUTTON_1
- #define NEON_LED LED_0
- #define OBSTACLE_DISTANCE_THRESHOLD 100
- #define NUM_OF_COLUMNS 2
- #define NUM_OF_ROWS 2

### Enumerations

- enum COLUMN_t { DEFAULT_COLUMN = 0 , CLIENT_COLUMN = 0 , CHARGER_COLUMN = 0 }
- enum ROW_t { CLIENT_ROW = 0 , DEFAULT_ROW = 1 , CHARGER_ROW = 2 }

### 5.2.1 Detailed Description

Configuration header file for app.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**



### 5.2.2 Macro Definition Documentation

#### 5.2.2.1 ITEM_PICKUP_BUTTON `#define ITEM_PICKUP_BUTTON BUTTON_1`

Button used to pick up an item is connected to BUTTON_1

Definition at line 13 of file app_cfg.h.

#### 5.2.2.2 NAVIGATION_MODE_BUTTON `#define NAVIGATION_MODE_BUTTON BUTTON_0`

Button used to navigate between modes is connected to BUTTON_0

Definition at line 12 of file app_cfg.h.

#### 5.2.2.3 NEON_LED `#define NEON_LED LED_0`

LED_0 is connected to the NEON_LED

Definition at line 15 of file app_cfg.h.

#### 5.2.2.4 NUM_OF_COLUMNS `#define NUM_OF_COLUMNS 2`

Number of columns on the arena

Definition at line 31 of file app_cfg.h.

#### 5.2.2.5 NUM_OF_ROWS `#define NUM_OF_ROWS 2`

Number of rows on the arena

Definition at line 32 of file app_cfg.h.

#### 5.2.2.6 OBSTACLE_DISTANCE_THRESHOLD `#define OBSTACLE_DISTANCE_THRESHOLD 100`

Distance threshold in cm for obstacle avoidance

Definition at line 29 of file app_cfg.h.

### 5.2.3 Enumeration Type Documentation

#### 5.2.3.1 COLUMN_t `enum COLUMN_t`

**Enumerator**

| | |
|---|---|
| DEFAULT_COLUMN | Default column of the robot at reset |
| CLIENT_COLUMN | Column of the client |
| CHARGER_COLUMN | Column of the charger |

Definition at line 17 of file app_cfg.h.

#### 5.2.3.2 ROW_t `enum ROW_t`

**Enumerator**

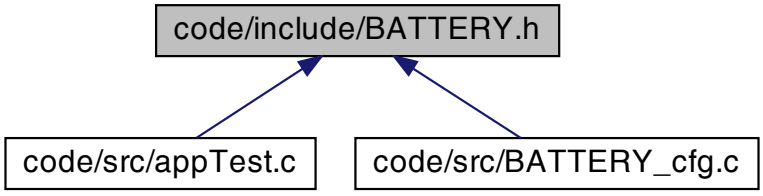
| | |
|---|---|
| CLIENT_ROW | Row of the client |
| DEFAULT_ROW | Default row of the robot at reset |
| CHARGER_ROW | Row of the charger |

Definition at line 23 of file app_cfg.h.

## 5.3 code/include/BATTERY.h File Reference

Interfaces header file for BATTERY.c.

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




### Functions

- void BATTERY_Init (void)
- STATE_t BATTERY_GetState (void)

### 5.3.1 Detailed Description

Interfaces header file for BATTERY.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**



### 5.3.2 Function Documentation

#### 5.3.2.1 BATTERY_GetState()

```
STATE_t BATTERY_GetState (
        void  )
```

#### 5.3.2.2 BATTERY_Init()

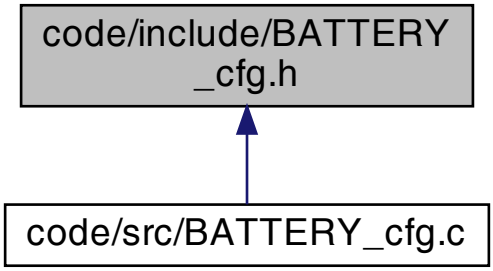
```
void BATTERY_Init (
        void  )
```

Here is the caller graph for this function:


## 5.4 code/include/BATTERY_cfg.h File Reference

Configuration header file for BATTERY.c.

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



**Data Structures**

- struct BatteryConfigs_t

**Macros**

- #define BATTERY_CAPACITY 18.0f /∗ 18 AH ∗/
- #define BATTERY_VOLTAGE 12.0f /∗ 12 V ∗/
- #define BATTERY_FULL_VOLTAGE 12.0f /∗ 12 V ∗/
- #define BATTERY_EMPTY_VOLTAGE 6.0f /∗ 6 V ∗/
- #define BATTERY_VOLTAGE_DIVIDER_RATIO (12 / 4.0f) /∗ 12V : 4V ∗/

**Variables**

- BatteryConfigs_t BatteryConfigs

  *Configurations for the Battery Management Module.*

### 5.4.1 Detailed Description

Configuration header file for BATTERY.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

Copyright (c) 2022

### 5.4.2 Macro Definition Documentation

#### 5.4.2.1 BATTERY_CAPACITY `#define BATTERY_CAPACITY 18.0f /* 18 AH */`

Definition at line 12 of file BATTERY_cfg.h.

#### 5.4.2.2 BATTERY_EMPTY_VOLTAGE `#define BATTERY_EMPTY_VOLTAGE 6.0f /* 6 V */`

Definition at line 15 of file BATTERY_cfg.h.

#### 5.4.2.3 BATTERY_FULL_VOLTAGE `#define BATTERY_FULL_VOLTAGE 12.0f /* 12 V */`

Definition at line 14 of file BATTERY_cfg.h.

#### 5.4.2.4 BATTERY_VOLTAGE `#define BATTERY_VOLTAGE 12.0f /* 12 V */`

Definition at line 13 of file BATTERY_cfg.h.

#### 5.4.2.5 BATTERY_VOLTAGE_DIVIDER_RATIO `#define BATTERY_VOLTAGE_DIVIDER_RATIO (12 / 4.0f) /* 12V : 4V */`

Definition at line 19 of file BATTERY_cfg.h.

### 5.4.3 Variable Documentation

#### 5.4.3.1 BatteryConfigs `BatteryConfigs_t BatteryConfigs [extern]`

Configurations for the Battery Management Module.

This is the configuration for the Battery Management Module. The configuration is done by the user. The user can change the configuration according to his needs.

**Note**

The configuration is done in the BATTERY_cfg.h and BATTERY_cfg.c files.

Definition at line 21 of file BATTERY_cfg.c.

## 5.5 code/include/BIT_MATH.h File Reference

Common bit manipulation operations.

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

### Macros

- #define GET_BIT(REGISTER, BIT) ( 1 & ( (REGISTER) >> (BIT) ) )

  *Read state of a specific bit.*
- #define SET_BIT(REGISTER, BIT) ( (REGISTER) |= (1 << (BIT)) )

  *Set state of a specific bit (set to 1)*
- #define CLR_BIT(REGISTER, BIT) ( (REGISTER) &= ~(1 << (BIT)) )

  *Clear state of a specific bit (set to 0)*
- #define TOG_BIT(REGISTER, BIT) ( (REGISTER) ^= (1 << (BIT)) )

  *Toggle state of a specific bit (set to 0)*
- #define BIT_IS_SET(REGISTER, Bit) ( (REGISTER) & (1 << (Bit)) )

  *Check if state of a specific bit is set (state = 1)*
- #define BIT_IS_CLEAR(REGISTER, Bit) ( !( (REGISTER) & (1 << (Bit)) ) )

  *Check if state of a specific bit is Cleared (state = 0)*
- #define CONCAT_8BITS(b7, b6, b5, b4, b3, b2, b1, b0) (0b##b7##b6##b5##b4##b3##b2##b1##b0)
- #define CONCAT_7BITS(b6, b5, b4, b3, b2, b1, b0) (0b##b6##b5##b4##b3##b2##b1##b0)
- #define CONCAT_6BITS(b5, b4, b3, b2, b1, b0) (0b##b5##b4##b3##b2##b1##b0)
- #define CONCAT_5BITS(b4, b3, b2, b1, b0) (0b##b4##b3##b2##b1##b0)
- #define CONCAT_4BITS(b3, b2, b1, b0) (0b##b3##b2##b1##b0)
- #define CONCAT_3BITS(b2, b1, b0) (0b##b2##b1##b0)
- #define CONCAT_2BITS(b1, b0) (0b##b1##b0)

### 5.5.1 Detailed Description

Common bit manipulation operations.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2021-07-31

### 5.5.2 Macro Definition Documentation

#### 5.5.2.1 BIT_IS_CLEAR

```
#define BIT_IS_CLEAR(
        REGISTER,
        Bit ) ( !( (REGISTER) & (1 << (Bit)) ) )
```

Check if state of a specific bit is Cleared (state = 0)

**Parameters**

| | | |
|---|---|---|
| in | *REGISTER* | the register includes the bit |
| in | *BIT* | the required bit number to be set |

**Returns**

1 or 0: 1 if the bit is cleared, 0 if the bit is set

**For example:**

BIT_IS_CLEAR(PORT_A, PIN0) will return 1 if bit 0 of PORT_A is LOW or 0 if it is HIGH

Definition at line 67 of file BIT_MATH.h.

#### 5.5.2.2 BIT_IS_SET

```
#define BIT_IS_SET(
        REGISTER,
        Bit ) ( (REGISTER) & (1 << (Bit)) )
```

Check if state of a specific bit is set (state = 1)

**Parameters**

| | | |
|---|---|---|
| in | *REGISTER* | the register includes the bit |
| in | *BIT* | the required bit number to be set |

**Returns**

1 or 0: 1 if the bit is set, 0 if the bit is cleared

**For example:**

BIT_IS_SET(PORT_A, PIN0) will return 1 if bit 0 of PORT_A is HIGH or 0 if it is LOW

Definition at line 56 of file BIT_MATH.h.

#### 5.5.2.3 CLR_BIT

```
#define CLR_BIT(
        REGISTER,
        BIT ) ( (REGISTER) &= ~(1 << (BIT)) )
```

Clear state of a specific bit (set to 0)

**Parameters**

| | | |
|---|---|---|
| in | *REGISTER* | the register includes the bit |
| in | *BIT* | the required bit number to be cleared |

**For example:**

CLEAR_BIT(PORT_A, PIN0) will set bit 0 of PORT_A to LOW (0)

Definition at line 37 of file BIT_MATH.h.

#### 5.5.2.4 CONCAT_2BITS

```
#define CONCAT_2BITS(
        b1,
        b0 ) (0b##b1##b0)
```

Definition at line 75 of file BIT_MATH.h.

#### 5.5.2.5 CONCAT_3BITS

```
#define CONCAT_3BITS(
        b2,
        b1,
        b0 ) (0b##b2##b1##b0)
```

Definition at line 74 of file BIT_MATH.h.

#### 5.5.2.6 CONCAT_4BITS

```
#define CONCAT_4BITS(
        b3,
        b2,
        b1,
        b0 ) (0b##b3##b2##b1##b0)
```

Definition at line 73 of file BIT_MATH.h.

#### 5.5.2.7 CONCAT_5BITS

```
#define CONCAT_5BITS(
        b4,
        b3,
        b2,
        b1,
        b0 ) (0b##b4##b3##b2##b1##b0)
```

Definition at line 72 of file BIT_MATH.h.

#### 5.5.2.8 CONCAT_6BITS

```
#define CONCAT_6BITS(
        b5,
        b4,
        b3,
        b2,
        b1,
        b0 ) (0b##b5##b4##b3##b2##b1##b0)
```

Definition at line 71 of file BIT_MATH.h.

#### 5.5.2.9 CONCAT_7BITS

```
#define CONCAT_7BITS(
        b6,
        b5,
        b4,
        b3,
        b2,
        b1,
        b0 ) (0b##b6##b5##b4##b3##b2##b1##b0)
```

Definition at line 70 of file BIT_MATH.h.

#### 5.5.2.10 CONCAT_8BITS

```
#define CONCAT_8BITS(
        b7,
        b6,
        b5,
        b4,
        b3,
        b2,
        b1,
        b0 ) (0b##b7##b6##b5##b4##b3##b2##b1##b0)
```

Definition at line 69 of file BIT_MATH.h.

#### 5.5.2.11 GET_BIT

```
#define GET_BIT(
        REGISTER,
        BIT ) ( 1 & ( (REGISTER) >> (BIT) ) )
```

Read state of a specific bit.

**Parameters**

| | | |
|---|---|---|
| in | *REGISTER* | the register includes the bit |
| in | *BIT* | the required bit number to be read |

**Returns**

state of the bit: 1 or 0

**For example:**

GET_BIT(PORT_A, PIN0) will return 1 if bit 0 of PORT_A is HIGH or 0 if it is LOW

Definition at line 19 of file BIT_MATH.h.

#### 5.5.2.12 SET_BIT

```
#define SET_BIT(
        REGISTER,
        BIT ) ( (REGISTER) |= (1 << (BIT)) )
```

Set state of a specific bit (set to 1)

**Parameters**

| | | |
|---|---|---|
| in | *REGISTER* | the register includes the bit |
| in | *BIT* | the required bit number to be set |

**For example:**

SET_BIT(PORT_A, PIN0) will set bit 0 of PORT_A to HIGH (1)

Definition at line 28 of file BIT_MATH.h.

#### 5.5.2.13 TOG_BIT

```
#define TOG_BIT(
        REGISTER,
        BIT ) ( (REGISTER) ^= (1 << (BIT)) )
```

Toggle state of a specific bit (set to 0)

**Parameters**

| | | |
|---|---|---|
| in | *REGISTER* | is the register includes the bit |
| in | *BIT* | the required bit number to be toggled |

**For example:**

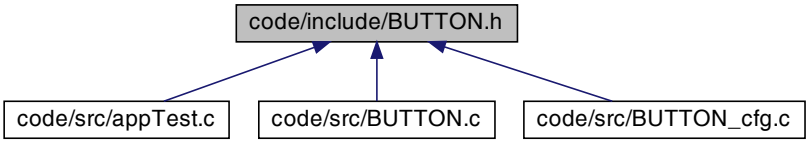
TOG_BIT(PORT_A, PIN0) will toggle bit 0 of PORT_A. So if it was HIGH, it will be LOW, and if it was LOW, it will be HIGH.

Definition at line 46 of file BIT_MATH.h.

## 5.6 code/include/BUTTON.h File Reference

Interfaces header file for BUTTON.c.

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




### Enumerations

- enum BUTTON_t {
  BUTTON_0 , BUTTON_1 , BUTTON_2 , BUTTON_3 ,
  BUTTON_4 , BUTTON_5 , BUTTON_6 , BUTTON_7 }

### Functions

- void BUTTON_Init (void)

  *Initializes Buttons connected to DIO.*
- STATE_t BUTTON_GetStatus (BUTTON_t button)

  *Check whether a specific button is pressed or not.*

## 5.6.1 Detailed Description

Interfaces header file for BUTTON.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

Copyright (c) 2022

## 5.6.2 Enumeration Type Documentation

### 5.6.2.1 BUTTON_t enum BUTTON_t

**Enumerator**

| | |
|---|---|
| BUTTON_0 | |
| BUTTON_1 | |
| BUTTON_2 | |
| BUTTON_3 | |
| BUTTON_4 | |
| BUTTON_5 | |
| BUTTON_6 | |
| BUTTON_7 | |

Definition at line 15 of file BUTTON.h.

### 5.6.3 Function Documentation

#### 5.6.3.1 BUTTON_GetStatus() `STATE_t BUTTON_GetStatus ( BUTTON_t button )`

Check whether a specific button is pressed or not.

**Parameters**

| | | |
|---|---|---|
| in | *button* | Button number: options from BUTTON_t enum in BUTTON.h file |

**Returns**

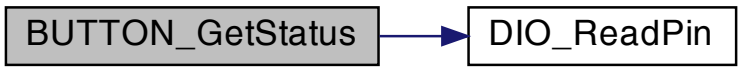
State of the button: HIGH if pressed and LOW if not, member of STATE_t enum

**For example:**

```
BUTTON_GetStatus(BUTTON_0);   //returns \ref HIGH if button 0 is pressed and \ref LOW otherwise
```

Definition at line 18 of file BUTTON.c.

Here is the call graph for this function:




#### 5.6.3.2 BUTTON_Init() `void BUTTON_Init ( void )`

Initializes Buttons connected to DIO.

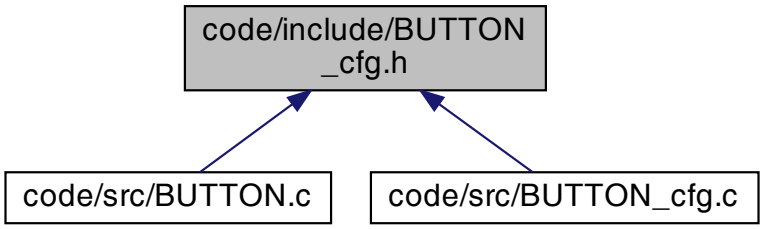
Definition at line 14 of file BUTTON.c.

Here is the caller graph for this function:

## 5.7 code/include/BUTTON_cfg.h File Reference

Configuration header file for BUTTON.c.

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




### Data Structures

- struct BUTTON_CONFIGS_t

### Enumerations

- enum DEBOUNCE_t { DEBOUNCE_OFF , DEBOUNCE_ON }

### Variables

- BUTTON_CONFIGS_t buttonsConfigs [ ]
- const u8 countButtonsConfigured

### 5.7.1 Detailed Description

Configuration header file for BUTTON.c.

Configuration source file for BUTTON.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

Copyright (c) 2022

### 5.7.2 Enumeration Type Documentation

#### 5.7.2.1 DEBOUNCE_t enum DEBOUNCE_t

**Enumerator**

| | |
|---|---|
| DEBOUNCE_OFF | |
| DEBOUNCE_ON | |

Definition at line 12 of file BUTTON_cfg.h.

### 5.7.3 Variable Documentation

#### 5.7.3.1 buttonsConfigs `BUTTON_CONFIGS_t buttonsConfigs[] [extern]`

**Note**

ACTIVE_LOW means that the pin is:

- LOW when the sensor is pressed
- HIGH when the sensor is not pressed ACTIVE_HIGH means that the pin is:
- HIGH when the sensor is pressed
- LOW when the sensor is not pressed

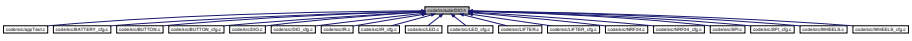
Definition at line 23 of file BUTTON_cfg.c.

#### 5.7.3.2 countButtonsConfigured `const u8 countButtonsConfigured [extern]`

Definition at line 28 of file BUTTON_cfg.c.

## 5.8 code/include/DIO.h File Reference

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



### Enumerations

- enum PIN_t {
  PIN_0 , PIN_1 , PIN_2 , PIN_3 ,
  PIN_4 , PIN_5 , PIN_6 , PIN_7 }
- enum PORT_t {
  PORT_A , PORT_B , PORT_C , PORT_D ,
  PORT_E , PORT_F , PORT_G }
- enum DIR_t { INPUT , OUTPUT }
- enum PULLUP_t { PULLUP_TRUE , PULLUP_FALSE }

### Functions

- void DIO_Init ()

  *Initialize DIO configurations based on user configurations in DIO_cfg.h and DIO_cfg.c.*
- void DIO_InitPin (PIN_t pin, PORT_t port, DIR_t direction, PULLUP_t pullup)

  *Initialize a pin as input or output.*
- void DIO_WritePin (const PIN_t pin, const PORT_t port, const STATE_t pinState)

  *write a value on the output pins, options are defined in STD_TYPES.h in the enum STATE_t*
- void DIO_WritePort (const PORT_t port, const u8 value)

  *write a value on a specific port (value of 8-bits ranges from 0 to 255)*
- STATE_t DIO_ReadPin (const PIN_t pin, const PORT_t port)

  *Read the state of a pin.*
- u8 DIO_ReadPort (const PORT_t port)

  *Read the state of the port (8 bits --> 0-255)*

## 5.8.1 Enumeration Type Documentation

### 5.8.1.1 DIR_t `enum DIR_t`

**Enumerator**

| | |
|---|---|
| INPUT | |
| OUTPUT | |

Definition at line 36 of file DIO.h.

### 5.8.1.2 PIN_t `enum PIN_t`

**Enumerator**

| | |
|---|---|
| PIN↩ _0 | |
| PIN↩ _1 | |
| PIN↩ _2 | |
| PIN↩ _3 | |
| PIN↩ _4 | |
| PIN↩ _5 | |
| PIN↩ _6 | |
| PIN↩ _7 | |

Definition at line 15 of file DIO.h.

#### 5.8.1.3 PORT_t enum PORT_t

**Enumerator**

| | |
|---|---|
| PORT_A | |
| PORT_B | |
| PORT_C | |
| PORT_D | |
| PORT_E | |
| PORT_F | |
| PORT_G | |

Definition at line 26 of file DIO.h.

#### 5.8.1.4 PULLUP_t enum PULLUP_t

**Enumerator**

| | |
|---|---|
| PULLUP_TRUE | |
| PULLUP_FALSE | |

Definition at line 41 of file DIO.h.

### 5.8.2 Function Documentation

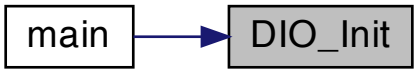
#### 5.8.2.1 DIO_Init() void DIO_Init ( void )

Initialize DIO configurations based on user configurations in DIO_cfg.h and DIO_cfg.c.

Initialize DIO pins to a specific direction (input or output), pullup or not according to the configuration in the DIO_cfg.h file.

Definition at line 67 of file DIO.c.

Here is the caller graph for this function:




#### 5.8.2.2 DIO_InitPin()

```
void DIO_InitPin (
        const PIN_t pin,
        const PORT_t port,
        const DIR_t direction,
        const PULLUP_t pullup )
```

Initialize a pin as input or output.

**Parameters**

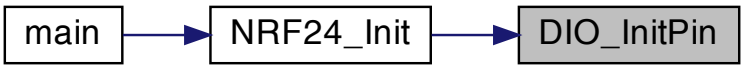
| | | |
|---|---|---|
| in | *pin* | The pin to be initialized: PIN0 ... PIN7 |
| in | *port* | The port of the pin: PORT_A ... PORT_G. |
| in | *direction* | The direction of the pin: INPUT or OUTPUT. |
| in | *pullup* | The pullup of the pin: PULLUP_TRUE or PULLUP_FALSE. |

If:

- DIO pin is not configured in the DIO_cfg.h file
- Or the pin is configurations need to be modified Then, this function will be called to modify the pin configuration.

Definition at line 110 of file DIO.c.

Here is the caller graph for this function:



#### 5.8.2.3 DIO_ReadPin()

```
STATE_t DIO_ReadPin (
        const PIN_t pin,
        const PORT_t port )
```

Read the state of a pin.

**Parameters**

| | | |
|---|---|---|
| in | *pin* | the pin to be initialized, PIN0, PIN1, ..., PIN7 |
| in | *port* | the port of the pin to be initialized, PORT_A, PORT_B, ..., PORT_G |

**Returns**

state of the pin, HIGH or LOW

**Example:**

```
DIO_ReadPin(PIN0, PORT_A);    // return the state of PIN0 on PORT A
DIO_ReadPin(PIN6, PORT_B);    // return the state of PIN6 on PORT B
```

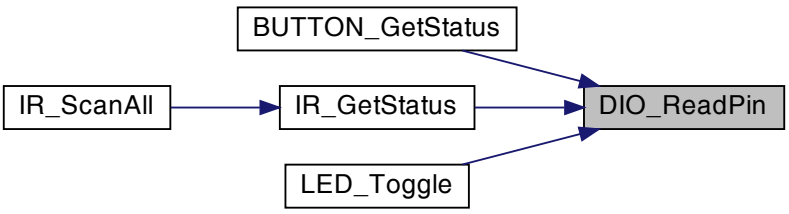
**Warning**

If the pin is not configured in the DIO_cfg.h file, then this function will do nothing.

If the pin is configured in the DIO_cfg.h file, then this function can be called to read the pin (1 or 0).

Definition at line 273 of file DIO.c.

Here is the caller graph for this function:




#### 5.8.2.4 DIO_ReadPort()

```
u8 DIO_ReadPort (
        const PORT_t port )
```

Read the state of the port (8 bits --> 0-255)

**Parameters**

| | | |
|---|---|---|
| in | *port* | the port to be read, PORT_A, PORT_B, ..., PORT_G |

**Returns**

value of the port (8 bits --> 0-255)

**Example:**

```
DIO_ReadPort(PORT_A);  // return 0xFF when all pins of PORT A are high
```

```
DIO_ReadPort(PORT_A);  // return 0x00 when all pins of PORT A are low
DIO_ReadPort(PORT_A);  // return 0xF0 when pins (4~7) of PORT A are high
```

**Warning**

If the pin is not configured in the DIO_cfg.h file, then this function return LOW.

Read the value of the port (all pins).

Definition at line 321 of file DIO.c.

#### 5.8.2.5 DIO_WritePin()

```
void DIO_WritePin (
        const PIN_t pin,
        const PORT_t port,
        const STATE_t pinState )
```

write a value on the output pins, options are defined in STD_TYPES.h in the enum STATE_t

**Parameters**

| | | |
|---|---|---|
| in | *pin* | the pin to be initialized, PIN0, PIN1, ..., PIN7 |
| in | *port* | the port of the pin to be initialized, PORT_A, PORT_B, ..., PORT_G |
| in | *pinState* | state of the pin, high or low, options are defined in STD_TYPES.h in the enum STATE_t |

**Example:**

```
DIO_WritePin(PIN0, PORT_A, HIGH);     // turns on pin 0 of port A
DIO_WritePin(PIN0, PORT_A, LOW);      // turns off pin 0 of port A
```

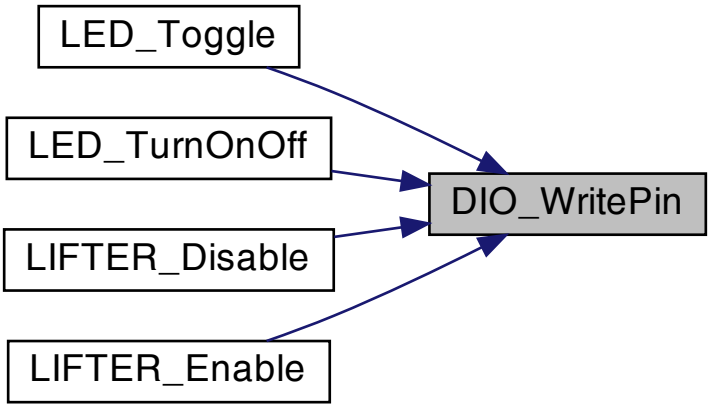
**Warning**

If the pin is not configured in the DIO_cfg.h file, then this function will do nothing.

If the pin is configured in the DIO_cfg.h file, then this function can be called to write to the pin (1 or 0).

Definition at line 149 of file DIO.c.

Here is the caller graph for this function:




#### 5.8.2.6 DIO_WritePort() `void DIO_WritePort (`

```
const PORT_t port,
const u8 value )
```

write a value on a specific port (value of 8-bits ranges from 0 to 255)

**Parameters**

| | | |
|---|---|---|
| in | *port* | The port to be modified, PORT_A, PORT_B, ..., PORT_G |
| in | *value* | value to set on the port (8 bits --> 0-255) |

**Example:**

```
DIO_WritePort(PORT_A, 0xFF);  // sets all pins of port A to high
DIO_WritePort(PORT_A, 0x00);  // sets all pins of port A to low
DIO_WritePort(PORT_A, 0xF0);  // sets pins 4, 5, 6, 7 of port A to high
```

**Warning**

If the pin is not configured in the DIO_cfg.h file, then this function will do nothing.

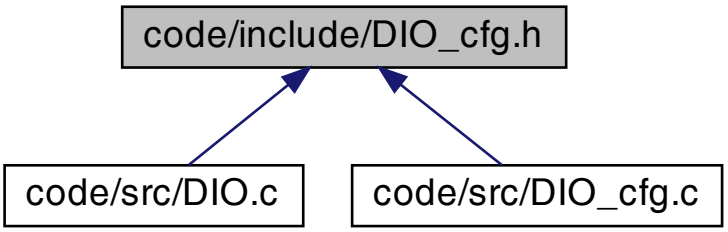
Write a value to the port (all pins).

Definition at line 234 of file DIO.c.

## 5.9 code/include/DIO_cfg.h File Reference

Configuration header file for DIO.c.

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




### Data Structures

- struct PinConfig_t

### Variables

- PinConfig_t pinConfigs [ ]
- const u8 countPinsConfigured

### 5.9.1 Detailed Description

Configuration header file for DIO.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

Copyright (c) 2022

### 5.9.2 Variable Documentation

#### 5.9.2.1 countPinsConfigured `const u8 countPinsConfigured [extern]`

Definition at line 53 of file DIO_cfg.c.

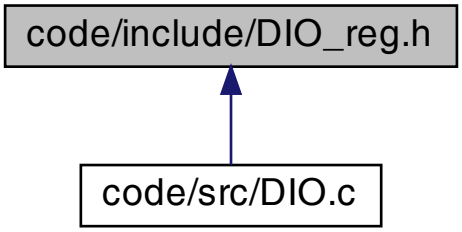
#### 5.9.2.2 pinConfigs `PinConfig_t pinConfigs[] [extern]`

Definition at line 14 of file DIO_cfg.c.

## 5.10 code/include/DIO_reg.h File Reference

DIO Registers of ATmega328p microcontroller.

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




**Macros**

- #define PINA (∗ ((volatile u8 ∗) 0x39) )
- #define DDRA (∗ ((volatile u8 ∗) 0x3A) )
- #define PORTA (∗ ((volatile u8 ∗) 0x3B) )
- #define PINB (∗ ((volatile u8 ∗) 0x36) )
- #define DDRB (∗ ((volatile u8 ∗) 0x37) )
- #define PORTB (∗ ((volatile u8 ∗) 0x38) )
- #define PINC (∗ ((volatile u8 ∗) 0x33) )
- #define DDRC (∗ ((volatile u8 ∗) 0x34) )
- #define PORTC (∗ ((volatile u8 ∗) 0x35) )
- #define PIND (∗ ((volatile u8 ∗) 0x30) )
- #define DDRD (∗ ((volatile u8 ∗) 0x31) )
- #define PORTD (∗ ((volatile u8 ∗) 0x32) )
- #define PINE (∗ ((volatile u8 ∗) 0x21) )
- #define DDRE (∗ ((volatile u8 ∗) 0x22) )
- #define PORTE (∗ ((volatile u8 ∗) 0x23) )
- #define PINF (∗ ((volatile u8 ∗) 0x20) )
- #define DDRF (∗ ((volatile u8 ∗) 0x61) )
- #define PORTF (∗ ((volatile u8 ∗) 0x62) )
- #define PING (∗ ((volatile u8 ∗) 0x63) )
- #define DDRG (∗ ((volatile u8 ∗) 0x64) )
- #define PORTG (∗ ((volatile u8 ∗) 0x65) )

### 5.10.1 Detailed Description

DIO Registers of ATmega328p microcontroller.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2021-07-31

### 5.10.2 Macro Definition Documentation

#### 5.10.2.1 DDRA `#define DDRA (* ((volatile u8 *) 0x3A) )`

Port A Data Direction Register

Definition at line 12 of file DIO_reg.h.

#### 5.10.2.2 DDRB `#define DDRB (* ((volatile u8 *) 0x37) )`

Port B Data Direction Register

Definition at line 16 of file DIO_reg.h.

#### 5.10.2.3 DDRC `#define DDRC (* ((volatile u8 *) 0x34) )`

Port C Data Direction Register

Definition at line 20 of file DIO_reg.h.

#### 5.10.2.4 DDRD `#define DDRD (* ((volatile u8 *) 0x31) )`

Port D Data Direction Register

Definition at line 24 of file DIO_reg.h.

#### 5.10.2.5 DDRE `#define DDRE (* ((volatile u8 *) 0x22) )`

Port E Data Direction Register

Definition at line 28 of file DIO_reg.h.

#### 5.10.2.6 DDRF `#define DDRF (* ((volatile u8 *) 0x61) )`

Port F Data Direction Register

Definition at line 32 of file DIO_reg.h.

#### 5.10.2.7 DDRG `#define DDRG (* ((volatile u8 *) 0x64) )`

Port G Data Direction Register

Definition at line 36 of file DIO_reg.h.

#### 5.10.2.8 PINA `#define PINA (* ((volatile u8 *) 0x39) )`

Port A Input Pins

Definition at line 11 of file DIO_reg.h.

#### 5.10.2.9 PINB `#define PINB (* ((volatile u8 *) 0x36) )`

Port B Input Pins

Definition at line 15 of file DIO_reg.h.

#### 5.10.2.10 PINC `#define PINC (* ((volatile u8 *) 0x33) )`

Port C Input Pins

Definition at line 19 of file DIO_reg.h.

#### 5.10.2.11 PIND `#define PIND (* ((volatile u8 *) 0x30) )`

Port D Input Pins

Definition at line 23 of file DIO_reg.h.

#### 5.10.2.12 PINE `#define PINE (* ((volatile u8 *) 0x21) )`

Port E Input Pins

Definition at line 27 of file DIO_reg.h.

#### 5.10.2.13 PINF `#define PINF (* ((volatile u8 *) 0x20) )`

Port F Input Pins

Definition at line 31 of file DIO_reg.h.

#### 5.10.2.14 PING `#define PING (* ((volatile u8 *) 0x63) )`

Port G Input Pins

Definition at line 35 of file DIO_reg.h.

#### 5.10.2.15 PORTA `#define PORTA (* ((volatile u8 *) 0x3B) )`

Port A Data Register

Definition at line 13 of file DIO_reg.h.

#### 5.10.2.16 PORTB `#define PORTB (* ((volatile u8 *) 0x38) )`

Port B Data Register

Definition at line 17 of file DIO_reg.h.

#### 5.10.2.17 PORTC `#define PORTC (* ((volatile u8 *) 0x35) )`

Port C Data Register

Definition at line 21 of file DIO_reg.h.

#### 5.10.2.18 PORTD `#define PORTD (* ((volatile u8 *) 0x32) )`

Port D Data Register

Definition at line 25 of file DIO_reg.h.

#### 5.10.2.19 PORTE `#define PORTE (* ((volatile u8 *) 0x23) )`

Port E Data Register

Definition at line 29 of file DIO_reg.h.

#### 5.10.2.20 PORTF `#define PORTF (* ((volatile u8 *) 0x62) )`

Port F Data Register

Definition at line 33 of file DIO_reg.h.

#### 5.10.2.21 PORTG `#define PORTG (* ((volatile u8 *) 0x65) )`

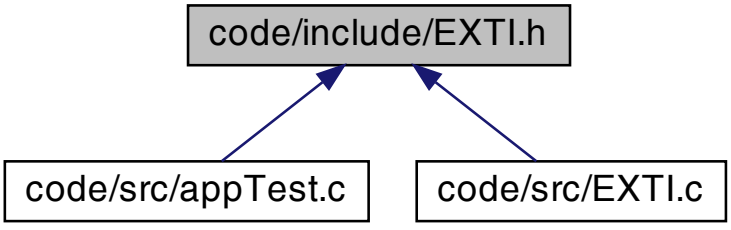
Port G Data Register

Definition at line 37 of file DIO_reg.h.

## 5.11 code/include/EXTI.h File Reference

Interfaces header file for EXTI.c.

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



### Enumerations

- enum EXTI_SENSITIVITY_t { FALLING_EDGE , RISING_EDGE , LOW_LEVEL_DETECT , LOGIC_CHANGE }
- enum EXTI_t { EXTI_0 , EXTI_1 , EXTI_2 , EXTI_3 , EXTI_4 , EXTI_5 , EXTI_6 , EXTI_7 }

### Functions

- void EXTI_Init (const EXTI_t extiNumber, const EXTI_SENSITIVITY_t sensitivity, void(∗const callback↩ Ptr)(void))

  *Initialize an EXTI pin with a given sensitivity and callback function.*
- void EXTI_EnableExternalInterrupt (const EXTI_t extiNumber)

  *Enable an EXTI pin (EXTI0 - EXTI7)*
- void EXTI_DisableExternalInterrupt (const EXTI_t extiNumber)

  *Disable an EXTI pin (EXTI0 - EXTI7)*

## 5.11.1 Detailed Description

Interfaces header file for EXTI.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

Copyright (c) 2022

## 5.11.2 Enumeration Type Documentation

### 5.11.2.1 EXTI_SENSITIVITY_t enum EXTI_SENSITIVITY_t

**Enumerator**

| | |
|---|---|
| FALLING_EDGE | |
| RISING_EDGE | |
| LOW_LEVEL_DETECT | |
| LOGIC_CHANGE | |

Definition at line 15 of file EXTI.h.

#### 5.11.2.2 EXTI_t enum EXTI_t

**Enumerator**

| | |
|---|---|
| EXTI_0 | |
| EXTI_1 | |
| EXTI_2 | |
| EXTI_3 | |
| EXTI_4 | |
| EXTI_5 | |
| EXTI_6 | |
| EXTI_7 | |

Definition at line 22 of file EXTI.h.

### 5.11.3 Function Documentation

#### 5.11.3.1 EXTI_DisableExternalInterrupt() void EXTI_DisableExternalInterrupt ( const EXTI_t *extiNumber* )

Disable an EXTI pin (EXTI0 - EXTI7)

**Parameters**

| | | |
|---|---|---|
| in | *extiNumber* | The EXTI pin to disable (EXTI0 - EXTI7) |

Definition at line 501 of file EXTI.c.

#### 5.11.3.2 EXTI_EnableExternalInterrupt() void EXTI_EnableExternalInterrupt ( const EXTI_t *extiNumber* )

Enable an EXTI pin (EXTI0 - EXTI7)

**Parameters**

| | | |
|---|---|---|
| in | *extiNumber* | The EXTI pin to enable (EXTI0 - EXTI7) |

Enable external interrupt pin

Definition at line 453 of file EXTI.c.

Here is the call graph for this function:


#### 5.11.3.3 EXTI_Init()

```
void EXTI_Init (
    const EXTI_t extiNumber,
    const EXTI_SENSITIVITY_t sensitivity,
    void(*)(void) callbackPtr )
```

Initialize an EXTI pin with a given sensitivity and callback function.

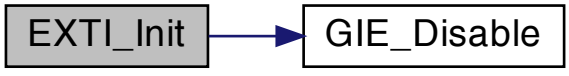
**Parameters**

| | | |
|---|---|---|
| in | *extiNumber* | The EXTI pin to initialize (EXTI0 - EXTI7) |
| in | *sensitivity* | The sensitivity of the EXTI pin (FALLING_EDGE, RISING_EDGE, LOW_LEVEL_DETECT, LOGIC_CHANGE) |
| in | *callbackPtr* | The callback function to be called when the EXTI pin is triggered |

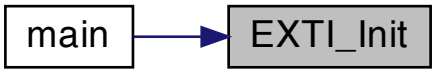
Initialize an external interrupt pin as input pin and set the

Definition at line 434 of file EXTI.c.

Here is the call graph for this function:



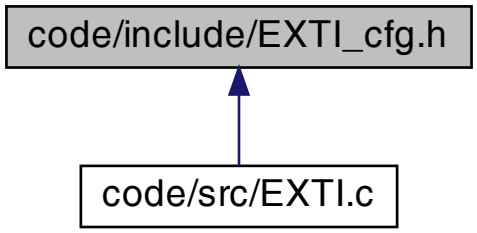
Here is the caller graph for this function:




## 5.12 code/include/EXTI_cfg.h File Reference

Configuration header file for EXTI.c.

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




### Macros

- #define NESTING NESTING_ENABLED

  *Determine if nesting is allowed in the interrupt service routines. Options are: NESTING_DISABLED --> nesting is not allowed NESTING_ENABLED --> nesting is allowed.*
- #define NESTING_ENABLED 1
- #define NESTING_DISABLED 0

### 5.12.1 Detailed Description

Configuration header file for EXTI.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**



### 5.12.2 Macro Definition Documentation

#### 5.12.2.1 NESTING `#define NESTING NESTING_ENABLED`

Determine if nesting is allowed in the interrupt service routines. Options are: NESTING_DISABLED --> nesting is not allowed NESTING_ENABLED --> nesting is allowed.

Definition at line 18 of file EXTI_cfg.h.

#### 5.12.2.2 NESTING_DISABLED `#define NESTING_DISABLED 0`

Definition at line 25 of file EXTI_cfg.h.

#### 5.12.2.3 NESTING_ENABLED `#define NESTING_ENABLED 1`

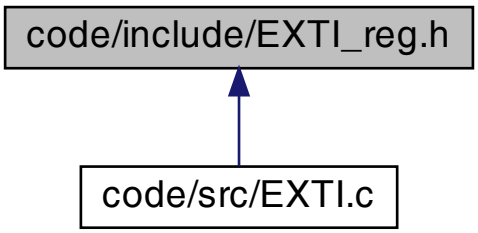
DO NOT CHANGE ANYTHING BELOW

Definition at line 24 of file EXTI_cfg.h.

## 5.13 code/include/EXTI_reg.h File Reference

EXTI Registers of ATmega328p MCU.

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



### Macros

- #define MCUCR (∗ ((volatile u8 ∗) 0x55) ) /∗ MCU Control Register (Used with bootloader only) ∗/
- #define EICRA (∗ ((volatile u8 ∗) 0x6A) ) /∗ External Interrupt Control Register A --> INT3:0 mode: falling, rising, or Low Level ∗/
- #define EICRB (∗ ((volatile u8 ∗) 0x5B) ) /∗ External Interrupt Control Register B --> INT7:4 mode: falling, rising, or Low Level ∗/
- #define EIMSK (∗ ((volatile u8 ∗) 0x59) ) /∗ External Interrupt Mask Register: Enable or Disable External Interrupts ∗/
- #define EIFR (∗ ((volatile u8 ∗) 0x58) ) /∗ External Interrupt Flag Register: Clear External Interrupts Flag ∗/

### Enumerations

- enum {
  IVCE , IVSEL , SM2 , SM0 ,
  SM1 , SE , SRW10 , SRE }
- enum {
  ISC00 , ISC01 , ISC10 , ISC11 ,
  ISC20 , ISC21 , ISC30 , ISC31 }
- enum {
  ISC40 , ISC41 , ISC50 , ISC51 ,
  ISC60 , ISC61 , ISC70 , ISC71 }
- enum {
  INT0 , INT1 , INT2 , INT3 ,
  INT4 , INT5 , INT6 , INT7 }
- enum {
  INTF0 , INTF1 , INTF2 , INTF3 ,
  INTF4 , INTF5 , INTF6 , INTF7 }

#### 5.13.1 Detailed Description

EXTI Registers of ATmega328p MCU.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2021-07-31

#### 5.13.2 Macro Definition Documentation

#### 5.13.2.1 EICRA `#define EICRA (* ((volatile u8 *) 0x6A) ) /* External Interrupt Control Register A --> INT3:0 mode: falling, rising, or Low Level */`

Definition at line 12 of file EXTI_reg.h.

#### 5.13.2.2 EICRB `#define EICRB (* ((volatile u8 *) 0x5B) ) /* External Interrupt Control Register B --> INT7:4 mode: falling, rising, or Low Level */`

Definition at line 13 of file EXTI_reg.h.

#### 5.13.2.3 EIFR `#define EIFR (* ((volatile u8 *) 0x58) ) /* External Interrupt Flag Register↩ : Clear External Interrupts Flag */`

Definition at line 15 of file EXTI_reg.h.

#### 5.13.2.4 EIMSK `#define EIMSK (* ((volatile u8 *) 0x59) ) /* External Interrupt Mask Register: Enable or Disable External Interrupts */`

Definition at line 14 of file EXTI_reg.h.

#### 5.13.2.5 MCUCR `#define MCUCR (* ((volatile u8 *) 0x55) ) /* MCU Control Register (Used with bootloader only) */`

Definition at line 11 of file EXTI_reg.h.

### 5.13.3 Enumeration Type Documentation

#### 5.13.3.1 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| IVCE | |
| IVSEL | |
| SM2 | |
| SM0 | |
| SM1 | |
| SE | |
| SRW10 | |
| SRE | |

Definition at line 17 of file EXTI_reg.h.

#### 5.13.3.2 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| ISC00 | |
| ISC01 | |
| ISC10 | |
| ISC11 | |
| ISC20 | |
| ISC21 | |
| ISC30 | |
| ISC31 | |

Definition at line 28 of file EXTI_reg.h.

#### 5.13.3.3 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| ISC40 | |
| ISC41 | |
| ISC50 | |
| ISC51 | |
| ISC60 | |
| ISC61 | |
| ISC70 | |
| ISC71 | |

Definition at line 39 of file EXTI_reg.h.

#### 5.13.3.4 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| INT0 | |
| INT1 | |
| INT2 | |
| INT3 | |
| INT4 | |
| INT5 | |
| INT6 | |
| INT7 | |

Definition at line 50 of file EXTI_reg.h.

#### 5.13.3.5 anonymous enum `anonymous enum`

**Enumerator**

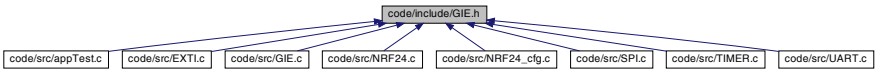
| | |
|---|---|
| INTF0 | |
| INTF1 | |
| INTF2 | |
| INTF3 | |
| INTF4 | |
| INTF5 | |
| INTF6 | |
| INTF7 | |

Definition at line 61 of file EXTI_reg.h.

## 5.14 code/include/GIE.h File Reference

Interfaces header file for GIE.c.

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




### Functions

- void GIE_Enable (void)
  *Global Interrupt Enable (GIE)*
- void GIE_Disable (void)
  *Global Interrupt Disable (GID)*

### 5.14.1 Detailed Description

Interfaces header file for GIE.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

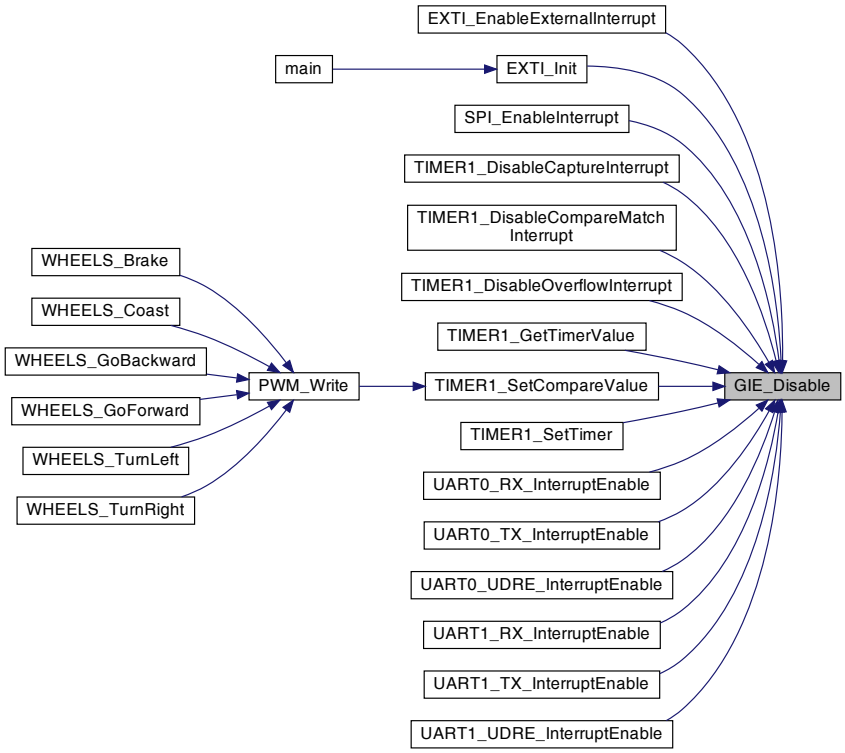
### 5.14.2 Function Documentation

#### 5.14.2.1 GIE_Disable() `void GIE_Disable ( void )`

Global Interrupt Disable (GID)

Definition at line 14 of file GIE.c.

Here is the caller graph for this function:

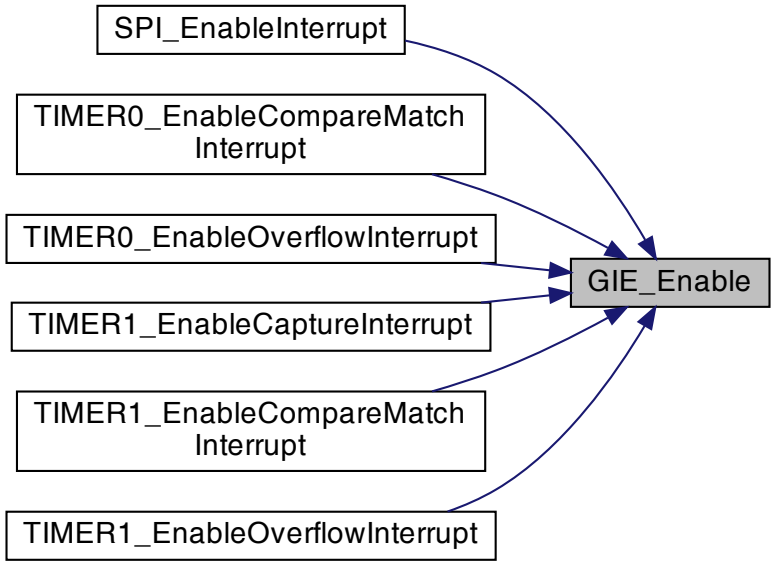



#### 5.14.2.2 GIE_Enable() `void GIE_Enable ( void )`

Global Interrupt Enable (GIE)

Definition at line 18 of file GIE.c.

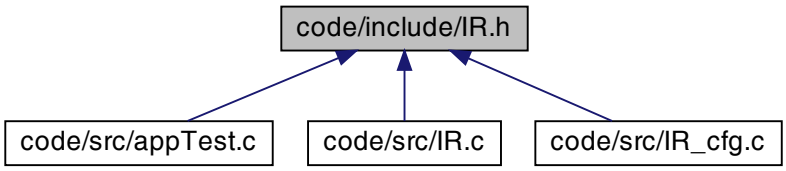
Here is the caller graph for this function:




## 5.15 code/include/IR.h File Reference

Interfaces header file for IR.c.

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




### Enumerations

- enum IR_SENSOR_t { IR_0 , IR_1 , IR_2 }

### Functions

- void IR_Init (void)

  *Initialize IR Sensors Configurations.*
- STATE_t IR_GetStatus (IR_SENSOR_t sensor)

*Get status of a specific IR Sensor.*

- u32 IR_ScanAll (void)

  *Scan all IR Sensors and return the status of all of them.*

- u8 IR_GetCount (void)

  *Get the number of configured IR sensors.*

### 5.15.1 Detailed Description

Interfaces header file for IR.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

Copyright (c) 2022

### 5.15.2 Enumeration Type Documentation

#### 5.15.2.1 IR_SENSOR_t `enum IR_SENSOR_t`

Typedefs

**Enumerator**

| | |
|---|---|
| IR↩ _0 | |
| IR↩ _1 | |
| IR↩ _2 | |

Definition at line 15 of file IR.h.

### 5.15.3 Function Documentation

#### 5.15.3.1 IR_GetCount() u8 IR_GetCount ( void )

Get the number of configured IR sensors.

**Returns**

Number of configured IR sensors

**Example:**

```
IR_GetNumOfSensors();  // returns 2 if only IR_0 and IR_1 are configured
```

Definition at line 51 of file IR.c.

#### 5.15.3.2 IR_GetStatus() STATE_t IR_GetStatus ( IR_SENSOR_t *sensor* )

Get status of a specific IR Sensor.

**Parameters**

| | | |
|---|---|---|
| in | *sensor* | Number of the sensor to be read; IR_0, IR_1, ..., IR7 |

**Returns**

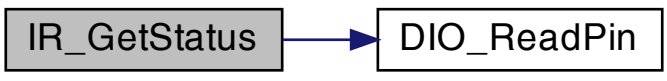
State of the sensor; HIGH if White, LOW if black.

**Example:**

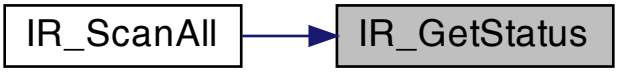
```
IR_GetStatus(IR_0);     // \ref HIGH if IR_0 is on white track and \ref LOW if black track, member of
 \ref STATE_t enum
```

Definition at line 18 of file IR.c.

Here is the call graph for this function:



Here is the caller graph for this function:



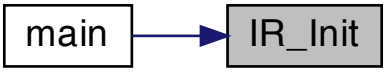

#### 5.15.3.3 IR_Init() `void IR_Init ( void )`

Initialize IR Sensors Configurations.

API FUNCTIONS

Definition at line 14 of file IR.c.

Here is the caller graph for this function:




#### 5.15.3.4 IR_ScanAll() `u32 IR_ScanAll ( void )`

Scan all IR Sensors and return the status of all of them.

**Returns**

State of all sensors; HIGH if White, LOW if black.

**Example:**

```
IR_ScanAll();
// when it returns a 0x0F00FFF0(0B0000_1111_0000_0000_1111_1111_1111_0000):
// This means:
//    * (IR_0 --> IR_15) and (IR_24 --> IR_27) are on white track.
//    * (IR_16 --> IR_23) and (IR_28 --> IR_31) are on black track.
```

**Note**

This function:

- Only scans the configured sensors. So, if you have configured only IR_0 and IR_1, this function will only return a maximum of 0x00000003 (0B0000_0000_0000_0000_0000_0000_0000_0011)
- Scans in the order of sensors' configurations. So, if you have configured IR_1 before IR_0 in the configuration, the status of IR_1 will be returned on bit 0 and the status of IR_0 will on bit 1.

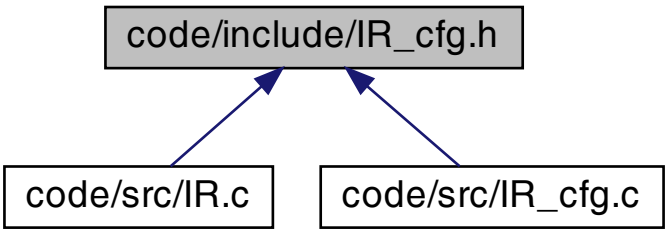
Definition at line 41 of file IR.c.

Here is the call graph for this function:


## 5.16 code/include/IR_cfg.h File Reference

Configuration header file for IR.c.

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




### Data Structures

- struct IR_CONFIG_t

### Variables

- IR_CONFIG_t IR_configs [ ]
- const u8 countIRSensorsConfigured

### 5.16.1 Detailed Description

Configuration header file for IR.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

Copyright (c) 2022

### 5.16.2 Variable Documentation

#### 5.16.2.1 countIRSensorsConfigured `const u8 countIRSensorsConfigured [extern]`

Definition at line 28 of file IR_cfg.c.

#### 5.16.2.2 IR_configs `IR_CONFIG_t IR_configs[] [extern]`

**Note**

ACTIVE_LOW means that the pin is:

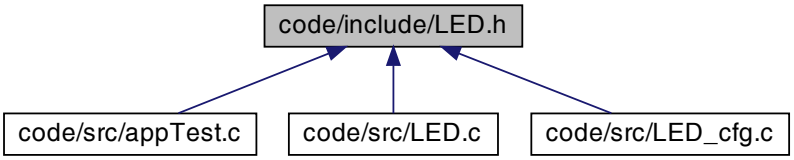
- LOW when the sensor is detecting an object (white)
- HIGH when the sensor is not detecting an object (black) ACTIVE_HIGH means that the pin is:
- HIGH when the sensor is detecting an object (white)
- LOW when the sensor is not detecting an object (black)

Definition at line 22 of file IR_cfg.c.

## 5.17 code/include/LED.h File Reference

Interfaces header file for LED.c.

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




### Enumerations

- enum LED_t {
  LED_0 , LED_1 , LED_2 , LED_3 ,
  LED_4 , LED_5 , LED_6 , LED_7 }
- enum LED_STATE_t { LED_OFF , LED_ON }

### Functions

- void LED_Init (void)

  *Initializes LEDs connected to DIO.*
- void LED_TurnOnOff (LED_t led, LED_STATE_t state)

  *Turns on/off a specific LED.*
- void LED_Toggle (LED_t led)

  *Toggle state of a specific LED.*

### 5.17.1 Detailed Description

Interfaces header file for LED.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

Copyright (c) 2022

### 5.17.2 Enumeration Type Documentation

#### 5.17.2.1 LED_STATE_t enum LED_STATE_t

**Enumerator**

| | |
|---|---|
| LED_OFF | |
| LED_ON | |

Definition at line 28 of file LED.h.

#### 5.17.2.2 LED_t `enum LED_t`

TYPEDEFS

**Enumerator**

| | |
|---|---|
| LED_0 | |
| LED_1 | |
| LED_2 | |
| LED_3 | |
| LED_4 | |
| LED_5 | |
| LED_6 | |
| LED_7 | |

Definition at line 17 of file LED.h.

### 5.17.3 Function Documentation

#### 5.17.3.1 LED_Init() `void LED_Init ( void )`

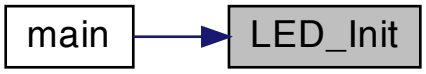
Initializes LEDs connected to DIO.

API's

Initializes LEDs connected to DIO.

Definition at line 17 of file LED.c.

Here is the caller graph for this function:




#### 5.17.3.2 LED_Toggle() `void LED_Toggle ( const LED_t led )`

Toggle state of a specific LED.

**Parameters**

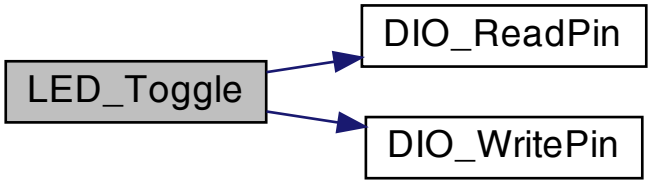
| | | |
|---|---|---|
| in | *led* | The LED to be oggles |

**Example:**

```
LED_Toggle(LED_0);   // toggle LED_0: LED_0 will be turned on if it was off and vice versa
```

Definition at line 45 of file LED.c.

Here is the call graph for this function:




#### 5.17.3.3 LED_TurnOnOff() `void LED_TurnOnOff ( const LED_t led, const LED_STATE_t state )`

Turns on/off a specific LED.

**Parameters**

| | | |
|---|---|---|
| in | *led* | the LED to be turned on/off, LED_0 to LED_7 |
| in | *state* | the state of the LED, LED_ON or LED_OFF |

**For example:**

- LED_TurnOnOff(LED_0, LED_ON) turns on LED_0
- LED_TurnOnOff(LED_0, LED_OFF) turns off LED_0

Turns on/off a specific LED.

**Parameters**

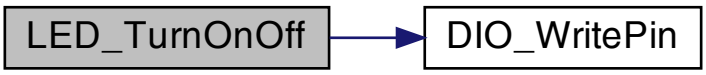
| | | |
|---|---|---|
| in | *led* | The LED to be turned on/off |
| in | *state* | The state of the LED, either LED_ON or LED_OFF |

**Example:**

```
LED_Set(LED_0, LED_ON);   // turn on LED_0
LED_Set(LED_0, LED_OFF);  // turn off LED_0
```

Definition at line 29 of file LED.c.

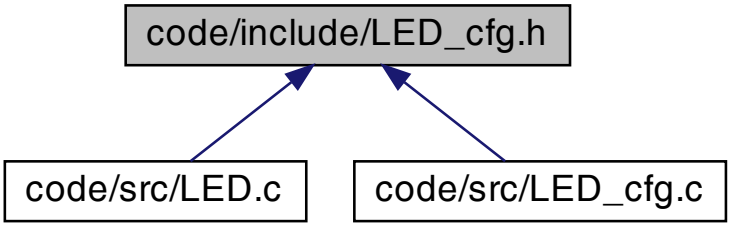
Here is the call graph for this function:




## 5.18 code/include/LED_cfg.h File Reference

Configuration header file for LED.c.

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



### Data Structures

- struct LED_CONFIGS_t

### Variables

- LED_CONFIGS_t ledConfigs [ ]
- const u8 countLedsConfigured

## 5.18.1 Detailed Description

Configuration header file for LED.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**



## 5.18.2 Variable Documentation

### 5.18.2.1 countLedsConfigured `const u8 countLedsConfigured [extern]`

Definition at line 19 of file LED_cfg.c.

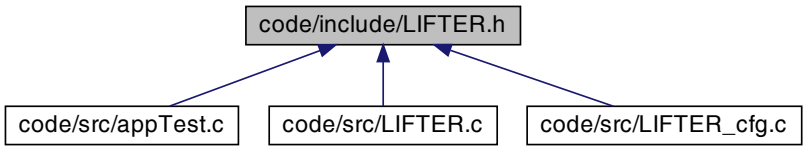
### 5.18.2.2 ledConfigs `LED_CONFIGS_t ledConfigs[] [extern]`

Definition at line 15 of file LED_cfg.c.

## 5.19 code/include/LIFTER.h File Reference

Interfaces header file for LIFTER.c.

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




### Functions

- void LIFTER_Init (void)
  *Initialize the lifter.*
- void LIFTER_MoveUp ()
  *Move the lifter up.*
- void LIFTER_MoveDown ()
  *Move the lifter down.*
- void LIFTER_Enable (void)
  *Enable the lifter motor.*
- void LIFTER_Disable (void)
  *Disable the lifter motor.*
- void LIFTER_SetSpeed (u8 speed)
  *Set the speed of the lifter motor.*
- void LIFTER_SetOverallStroke (u8 overallStroke)
  *Set the stroke of the lifter motor per revolution in mm.*
- void LIFTER_SetPulsesPerRevolution (u16 pulsesPerRevolution)
  *Set the number of pulses per revolution.*
- void LIFTER_SetRevolutionStroke (u8 revolutionStroke)
  *Set the distance per revolution.*

### 5.19.1 Detailed Description

Interfaces header file for LIFTER.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

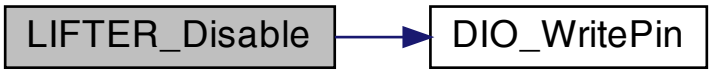
### 5.19.2 Function Documentation

#### 5.19.2.1 LIFTER_Disable() `void LIFTER_Disable ( void )`

Disable the lifter motor.

Definition at line 131 of file LIFTER.c.

Here is the call graph for this function:

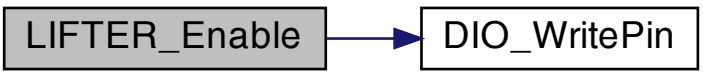



#### 5.19.2.2 LIFTER_Enable() `void LIFTER_Enable ( void )`

Enable the lifter motor.

Definition at line 124 of file LIFTER.c.

Here is the call graph for this function:



#### 5.19.2.3 LIFTER_Init() `void LIFTER_Init ( void )`

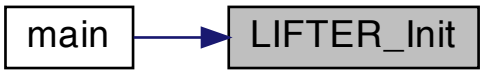
Initialize the lifter.

Initialize the lifter.

API FUNCTIONS IMPLEMENTATION ∗

Definition at line 103 of file LIFTER.c.

Here is the caller graph for this function:




#### 5.19.2.4 LIFTER_MoveDown() `void LIFTER_MoveDown ( void )`

Move the lifter down.

Move the lifter down.

Definition at line 117 of file LIFTER.c.

#### 5.19.2.5 LIFTER_MoveUp() `void LIFTER_MoveUp ( void )`

Move the lifter up.

Move the lifter up.

Definition at line 110 of file LIFTER.c.

#### 5.19.2.6 LIFTER_SetOverallStroke() `void LIFTER_SetOverallStroke ( const u8 overallStroke )`

Set the stroke of the lifter motor per revolution in mm.

**Parameters**

| | | |
|---|---|---|
| in | *overallStroke* | The stroke of the lifter motor per revolution in mm |

Definition at line 147 of file LIFTER.c.

#### 5.19.2.7 LIFTER_SetPulsesPerRevolution() `void LIFTER_SetPulsesPerRevolution ( const u16 pulsesPerRevolution )`

Set the number of pulses per revolution.

**Parameters**

| | | |
|---|---|---|
| in | *pulsesPerRevolution* | The number of pulses per revolution |

Definition at line 155 of file LIFTER.c.

#### 5.19.2.8 LIFTER_SetRevolutionStroke() `void LIFTER_SetRevolutionStroke ( const u8 revolutionStroke )`

Set the distance per revolution.

**Parameters**

| | | |
|---|---|---|
| in | *revolutionStroke* | The distance per revolution in mm |

Definition at line 163 of file LIFTER.c.

#### 5.19.2.9 LIFTER_SetSpeed() `void LIFTER_SetSpeed ( const u8 speed )`

Set the speed of the lifter motor.

**Parameters**

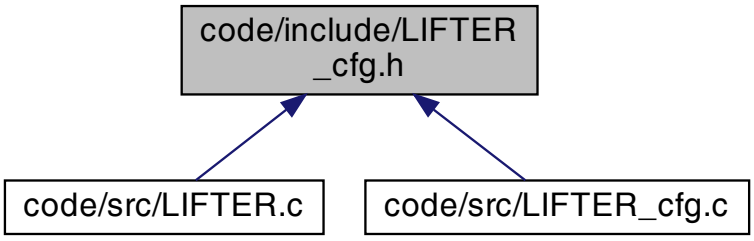
| | | |
|---|---|---|
| in | *speed* | The speed of the lifter motor |

Definition at line 139 of file LIFTER.c.

## 5.20 code/include/LIFTER_cfg.h File Reference

Configuration header file for LIFTER.c.

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




### Data Structures

- struct LIFTER_CONFIGS_t

### Macros

- #define ENABLE_CONNECTION 0

  *If you are using enable pin, Write 1, else write 0.*

### Enumerations

- enum LIFTER_DIR_t { LIFTER_UP , LIFTER_DOWN }

### Variables

- LIFTER_CONFIGS_t LifterConfigs

  *Lifter configurations.*

#### 5.20.1 Detailed Description

Configuration header file for LIFTER.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

### 5.20.2 Macro Definition Documentation

#### 5.20.2.1 ENABLE_CONNECTION `#define ENABLE_CONNECTION 0`

If you are using enable pin, Write 1, else write 0.

Definition at line 15 of file LIFTER_cfg.h.

### 5.20.3 Enumeration Type Documentation

#### 5.20.3.1 LIFTER_DIR_t `enum LIFTER_DIR_t`

DO NOT CHANGE ANYTHING BELOW THIS LINE

**Enumerator**

| | |
|---|---|
| LIFTER_UP | |
| LIFTER_DOWN | |

Definition at line 20 of file LIFTER_cfg.h.

### 5.20.4 Variable Documentation

#### 5.20.4.1 LifterConfigs `LIFTER_CONFIGS_t LifterConfigs [extern]`

Lifter configurations.

**Note**

stepSize is the number of millimeters that the lifter will move when calling LIFTER_move function.
For example, if the stepSize is 10, the lifter will move 10 millimeters when calling LIFTER_move function.

pulsePerRevolution is the number of pulses that the lifter will make to make one revolution.
For example, if the pulsePerRevolution is 200, the lifter will make 200 pulses to make one revolution. Options:

- 200 --> Full step
- 400 --> Half step
- 800 --> 1/4 step --> Not allowed with TB6560

- 1600 --> 1/8 step
- 3200 --> 1/16 step
- 6400 --> 1/32 step --> Not allowed with TB6560

distancePerRevolution is the number of millimeters that the lifter will move in one revolution.
For example, if the distancePerRevolution is 100, the lifter will move 100 millimeters in one revolution.

speed is the number of millimeters that the lifter will move in one second. For example, if the speed is 100, the lifter will move 100 millimeters in one second.

speed must be less <= stepSize

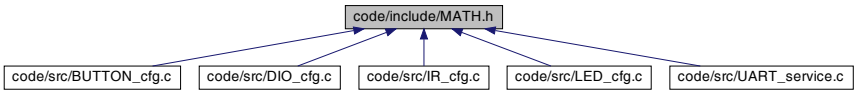
You can change default speed, overallStroke, pulsePerRevolution, and revolutionStroke by calling faunctions LIFTER_SetSpeed, LIFTER_SetOverallStroke, LIFTER_SetPulsesPerRevolution, and LIFTER_SetRevolution↩ Stroke. See prototypes of these functions for more details.

Definition at line 46 of file LIFTER_cfg.c.

## 5.21 code/include/MATH.h File Reference

Common math functions and constants.

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




### Macros

- #define PI 3.14159265358979323846
  *The value of PI constant.*
- #define CLAMP(x, min, max) ((x) < (min) ? (min) : ((x) > (max) ? (max) : (x)))
  *Get the **Clamp value between min and max.***
- #define DEG_TO_RAD(x) ((x) * PI / 180.0f)
  *Convert degrees to radians.*
- #define RAD_TO_DEG(x) ((x) * 180.0f / PI)
  *Convert radians to degrees.*
- #define MIN(a, b) ((a) < (b) ? (a) : (b))
  *Get the < b>minimum value between two values.*
- #define MAX(a, b) ((a) > (b) ? (a) : (b))
  *Get the < b>maximum value between two values.*
- #define ABS(x) ((x) < 0 ? -(x) : (x))
  *Absolute value of a number.*
- #define SIGN(x) ((x) < 0 ? -1 : 1)
  *Get the sign of a number.*
- #define IS_POSITIVE(x) ((x) > 0)
  *Check if the number is positive (greater than zero).*
- #define IS_NEGATIVE(x) ((x) < 0)
  *Check if the number is negative (less than zero).*
- #define FLOOR(x) ((int)(x) + ( (x) > 0 ? 0 : -1))
  *Get the floor value of a number. It is the largest integer that is less than or equal to x.*
- #define CEIL(x) ((int)(x) + ( (x) > 0 ? 1 : 0) )

*Get the Ceil value of a number. It is the smallest integer that is greater than or equal to x.*

- #define ROUND(x) ( (int) ( (x) + ( (x) > 0 ? 0.5f : -0.5f) ) )

  *Get the round value of a number. It is the nearest integer to x.*
- #define FRACTION(x) ((x) - (int)(x))

  *Get the fractional part of a floating point number.*
- #define LERP(a, b, t) ((a) + (t) * ((b) - (a))) /* Linear interpolation */

  *Gets the Linear Interpolation between two values.*
- #define SQRT(x)
- #define POW(x, y)
- #define LOG(x)
- #define LOG2(x)
- #define LOG10(x)
- #define EXP(x)
- #define ACOS(x) ( (-0.69813170079773212 * (x) * (x) - 0.87266462599716477) * (x) + 1.5707963267948966 )

  *Arc Cosine of an angle in radians.*
- #define ASIN(x) ( (0.69813170079773212 * (x) * (x) + 0.87266462599716477) * (x) + 1.5707963267948966 )

  *Arc Sine of an angle in radians.*
- #define ATAN(x) ( (0.55228474983079331 * (x)) + 1.5707963267948966 )

  *Arc Tangent of an angle in radians.*
- #define COS(x) ( (0.87266462599716477 * (x)) + 1.5707963267948966 )

  *Cosine of an angle in radians.*
- #define SIN(x) ( (0.69813170079773212 * (x)) + 1.5707963267948966 )

  *Sine of an angle in radians.*
- #define TAN(x) ( (0.87266462599716477 * (x)) + 1.5707963267948966 )

  *Tangent of an angle in radians.*
- #define SIZE_OF_ARRAY(array) ( sizeof(array) / sizeof(array[0]) )

  *This is a macro like function to get the size of an array in bytes.*

### 5.21.1 Detailed Description

Common math functions and constants.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-19

**Copyright**

Copyright (c) 2022

### 5.21.2 Macro Definition Documentation

#### 5.21.2.1 ABS `#define ABS( x ) ((x) < 0 ? -(x) : (x))`

Absolute value of a number.

**Parameters**

| | | |
|---|---|---|
| in | *x* | The number to take the absolute value of. |

**Returns**

The absolute value of x.

**Example:**

```
ABS(-1.0f);           // returns 1.0f
ABS(1.0f);            // returns 1.0f
ABS(0.0f);            // returns 0.0f
ABS(-0.0f);           // returns 0.0f
```

Definition at line 118 of file MATH.h.

#### 5.21.2.2 ACOS `#define ACOS( x ) ( (-0.69813170079773212 * (x) * (x) - 0.87266462599716477) * (x) + 1.5707963267948966 )`

Arc Cosine of an angle in radians.

**Parameters**

| | | |
|---|---|---|
| in | *x* | The value to find the Arc Cosine of. |

**Note**

It has a range of [0, PI].

It is the inverse of the Cosine function.

It has a maximum error of 0.18 radians.

Definition at line 241 of file MATH.h.

#### 5.21.2.3 ASIN `#define ASIN( x ) ( (0.69813170079773212 * (x) * (x) + 0.87266462599716477) * (x) + 1.5707963267948966 )`

Arc Sine of an angle in radians.

**Parameters**

| | | |
|---|---|---|
| in | *x* | The value to find the Arc Sine of. |

**Note**

It has a range of [-PI/2, PI/2].

It is the inverse of the Sine function.

It has a maximum error of 0.18 radians.

Definition at line 250 of file MATH.h.

#### 5.21.2.4 ATAN `#define ATAN( x ) ( (0.55228474983079331 * (x)) + 1.5707963267948966 )`

Arc Tangent of an angle in radians.

**Parameters**

| | | |
|---|---|---|
| in | *x* | The value to find the Arc Tangent of. |

**Note**

It has a range of [-PI/2, PI/2].

It is the inverse of the Tangent function.

It has a maximum error of 0.18 radians.

Definition at line 259 of file MATH.h.

#### 5.21.2.5 CEIL `#define CEIL( x ) ((int)(x) + ( (x) > 0 ? 1 : 0) )`

Get the Ceil value of a number. It is the smallest integer that is greater than or equal to x.

**Parameters**

| | | |
|---|---|---|
| in | *x* | The number to get the Ceil value of. |

**Returns**

The Ceil value of x.

**Example:**

```
CEIL(5.5f);   // returns 6
CEIL(-5.5f);  // returns -5
CEIL(1.33f);  // returns 2
```

Definition at line 165 of file MATH.h.

#### 5.21.2.6 CLAMP `#define CLAMP(`

```
x,
min,
max ) ((x) < (min) ? (min) : ((x) > (max) ? (max) : (x)))
```

Get the **Clamp value between min and max.**

**Parameters**

| | | |
|---|---|---|
| in | *value* | The value to clamp. |
| in | *min* | The minimum value. |
| in | *max* | The maximum value. |

**Returns**

The clamped value.

**Example:**

```
CLAMP(1.0f, 0.0f, 1.0f);    // returns 1.0f
CLAMP(0.0f, 0.0f, 1.0f);    // returns 0.0f
CLAMP(-1.0f, 0.0f, 1.0f);   // returns 0.0f
CLAMP(2.0f, 0.0f, 1.0f);    // returns 1.0f
```

Definition at line 38 of file MATH.h.

#### 5.21.2.7 COS `#define COS(`

```
x ) ( (0.87266462599716477 * (x)) + 1.5707963267948966 )
```

Cosine of an angle in radians.

**Parameters**

| | | |
|---|---|---|
| in | *x* | The value to find the Cosine of. |

**Note**

It has a range of [0, 2∗PI].

It is the inverse of the Arc Cosine function.

It has a maximum error of 0.18 radians.

Definition at line 268 of file MATH.h.

#### 5.21.2.8 DEG_TO_RAD `#define DEG_TO_RAD(`

```
x ) ((x) * PI / 180.0f)
```

Convert degrees to radians.

**Parameters**

| | | |
|---|---|---|
| in | *degrees* | The degrees to convert. |

**Returns**

The radians.

**Example:**

```
DEG2RAD(180.0f);      // returns PI
DEG2RAD(0.0f);        // returns 0.0f
DEG2RAD(-180.0f);     // returns -PI
DEG2RAD(360.0f);      // returns 2*PI
DEG2RAD(-360.0f);     // returns -2*PI
DEG2RAD(720.0f);      // returns 4*PI
DEG2RAD(-720.0f);     // returns -4*PI
DEG2RAD(255.0f);      // returns 4.45059
```

Definition at line 54 of file MATH.h.

#### 5.21.2.9 EXP `#define EXP( x )`

Definition at line 218 of file MATH.h.

#### 5.21.2.10 FLOOR `#define FLOOR( x ) ((int)(x) + ( (x) > 0 ? 0 : -1))`

Get the floor value of a number. It is the largest integer that is less than or equal to x.

**Parameters**

| | | |
|---|---|---|
| in | *x* | The number to get the floor value of. |

**Returns**

The floor value of x.

**Example:**

```
FLOOR(5.6f);          // returns 5
FLOOR(-5.3f);         // returns -6
FLOOR(1.33f);         // returns 1
FLOOR(-1.33f);        // returns -2
```

Definition at line 154 of file MATH.h.

#### 5.21.2.11 FRACTION `#define FRACTION( x ) ((x) - (int)(x))`

Get the fractional part of a floating point number.

**Parameters**

| | | |
|---|---|---|
| in | *x* | The number to get the fractional part of. |

**Returns**

The fractional part of x.

**Example:**

```
FRACTION(1.6f);           // returns 0.6f
FRACTION(-1.6f);          // returns -0.6f
FRACTION(1.33f);          // returns 0.33f
FRACTION(-1.33f);         // returns -0.33f
FRACTION(1.0f);           // returns 0.0f
FRACTION(-1.0f);          // returns 0.0f
FRACTION(0.0f);           // returns 0.0f
```

Definition at line 192 of file MATH.h.

#### 5.21.2.12 IS_NEGATIVE `#define IS_NEGATIVE( x ) ((x) < 0)`

Check if the number is negative (less than zero).

**Parameters**

| | | |
|---|---|---|
| in | *x* | The number to check. |

**Returns**

TRUE if x is negative, FALSE otherwise.

Definition at line 142 of file MATH.h.

#### 5.21.2.13 IS_POSITIVE `#define IS_POSITIVE( x ) ((x) > 0)`

Check if the number is positive (greater than zero).

**Parameters**

| | | |
|---|---|---|
| in | *x* | The number to check. |

**Returns**

TRUE if x is positive, FALSE otherwise.

Definition at line 135 of file MATH.h.

#### 5.21.2.14 LERP

```
#define LERP(
    a,
    b,
    t ) ((a) + (t) * ((b) - (a))) /* Linear interpolation */
```

Gets the Linear Interpolation between two values.

**Parameters**

| | | |
|---|---|---|
| in | *a* | The first value. |
| in | *b* | The second value. |
| in | *t* | The interpolation value. |

**Returns**

The interpolated value.

**Example:**

```
LERP(1.0f, 2.0f, 0.5f);          // returns 1.5f
LERP(1.0f, 2.0f, 0.0f);          // returns 1.0f
LERP(1.0f, 2.0f, 1.0f);          // returns 2.0f
LERP(1.0f, 2.0f, 2.0f);          // returns 2.0f
LERP(1.0f, 2.0f, -1.0f);         // returns 1.0f
LERP(1.0f, 2.0f, -2.0f);         // returns 1.0f
LERP(1.0f, 2.0f, 3.0f);          // returns 2.0f
LERP(1.0f, 2.0f, -3.0f);         // returns 1.0f
```

Definition at line 210 of file MATH.h.

#### 5.21.2.15 LOG

```
#define LOG(
    x )
```

Definition at line 215 of file MATH.h.

#### 5.21.2.16 LOG10

```
#define LOG10(
    x )
```

Definition at line 217 of file MATH.h.

#### 5.21.2.17 LOG2 #define LOG2( x )

Definition at line 216 of file MATH.h.

#### 5.21.2.18 MAX #define MAX( a, b ) ((a) > (b) ? (a) : (b))

Get the < b>maximum value between two values.

**Parameters**

| | | |
|---|---|---|
| in | *a* | The first value. |
| in | *b* | The second value. |

**Returns**

The maximum value of the first and second values.

**Example:**

```
MAX(1.0f, 2.0f);      // returns 2.0f
MAX(2.0f, 1.0f);      // returns 2.0f
MAX(1.0f, 1.0f);      // returns 1.0f
MAX(2.0f, 2.0f);      // returns 2.0f
MAX(0.0f, -1.0f);     // returns 0.0f
MAX(-1.0f, 0.0f);     // returns 0.0f
MAX(-1.0f, -1.0f);    // returns -1.0f
MAX(-2.0f, -1.0f);    // returns -1.0f
MAX(-1.0f, -2.0f);    // returns -1.0f
```

Definition at line 106 of file MATH.h.

#### 5.21.2.19 MIN #define MIN( a, b ) ((a) < (b) ? (a) : (b))

Get the < b>minimum value between two values.

**Parameters**

| | | |
|---|---|---|
| in | *a* | The first value. |
| in | *b* | The second value. |

**Returns**

The minimum value of the first and second values.

**Example:**

```
MIN(1.0f, 2.0f);      // returns 1.0f
MIN(2.0f, 1.0f);      // returns 1.0f
MIN(1.0f, 1.0f);      // returns 1.0f
MIN(2.0f, 2.0f);      // returns 2.0f
MIN(0.0f, -1.0f);     // returns -1.0f
MIN(-1.0f, 0.0f);     // returns -1.0f
MIN(-1.0f, -1.0f);    // returns -1.0f
MIN(-2.0f, -1.0f);    // returns -2.0f
MIN(-1.0f, -2.0f);    // returns -2.0f
```

Definition at line 88 of file MATH.h.

#### 5.21.2.20 PI `#define PI 3.14159265358979323846`

The value of PI constant.

**Note**

This value is used in the trigonometric functions.

Definition at line 24 of file MATH.h.

#### 5.21.2.21 POW `#define POW(`

*x,*
*y )*

Definition at line 214 of file MATH.h.

#### 5.21.2.22 RAD_TO_DEG `#define RAD_TO_DEG(`

*x* `) ((x) * 180.0f / PI)`

Convert radians to degrees.

**Parameters**

| | | |
|---|---|---|
| in | *radians* | The radians to convert. |

**Returns**

The degrees.

**Example:**

```
RAD2DEG(PI);          // returns 180.0f
RAD2DEG(0.0f);        // returns 0.0f
RAD2DEG(-PI);         // returns -180.0f
RAD2DEG(2*PI);        // returns 360.0f
RAD2DEG(-2*PI);       // returns -360.0f
RAD2DEG(4*PI);        // returns 720.0f
RAD2DEG(-4*PI);       // returns -720.0f
RAD2DEG(4.45059);     // returns 255.0f
```

Definition at line 70 of file MATH.h.

#### 5.21.2.23 ROUND `#define ROUND( x ) ( (int) ( (x) + ( (x) > 0 ? 0.5f : -0.5f) ) )`

Get the round value of a number. It is the nearest integer to x.

**Parameters**

| | | |
|---|---|---|
| in | *x* | The number to get the round value of. |

**Returns**

The round value of x.

**Example:**

```
ROUND(1.6f);      // returns 2.0f
ROUND(-1.6f);     // 1.6f -2.0f
ROUND(1.33);      // returns 1.0f
ROUND(-1.33f);    // returns -1.0f
```

Definition at line 177 of file MATH.h.

#### 5.21.2.24 SIGN `#define SIGN( x ) ((x) < 0 ? -1 : 1)`

Get the sign of a number.

**Parameters**

| | | |
|---|---|---|
| in | *x* | The number to get the sign of. |

**Returns**

-1 if x is negative, 1 if x is positive, 0 if x is zero.

**Example:**

```
SIGN(-5);             // returns -1
SIGN(5);              // returns 1
```

Definition at line 128 of file MATH.h.

#### 5.21.2.25 SIN `#define SIN( x ) ( (0.69813170079773212 * (x)) + 1.5707963267948966 )`

Sine of an angle in radians.

**Parameters**

| | | |
|---|---|---|
| in | *x* | The value to find the Sine of. |

**Note**

It has a range of [-PI/2, PI/2].

It is the inverse of the Arc Sine function.

It has a maximum error of 0.18 radians.

Definition at line 277 of file MATH.h.

#### 5.21.2.26 SIZE_OF_ARRAY `#define SIZE_OF_ARRAY( array ) ( sizeof(array) / sizeof(array[0]) )`

This is a macro like function to get the size of an array in bytes.

**Parameters**

| | | |
|---|---|---|
| in | *array* | The name of the array |

**Returns**

The size of the array in bytes

**Warning**

This macro is not intended to be used to get the size of a dynamic array. The array must be declared at compile time. This is because the sizeof operator is a compile time operator and cannot be used to get the size of a dynamic array.

**Example:**

```
SIZE_OF_ARRAY(arrayName);   // returns the size of the array <arrayName> in bytes
```

Definition at line 314 of file MATH.h.

#### 5.21.2.27 SQRT `#define SQRT( x )`

Definition at line 213 of file MATH.h.

#### 5.21.2.28 TAN `#define TAN( x ) ( (0.87266462599716477 * (x)) + 1.5707963267948966 )`

Tangent of an angle in radians.

**Parameters**

| | | |
|---|---|---|
| in | *x* | The value to find the Tangent of. |

**Note**

It has a range of [-PI/2, PI/2].

It is the inverse of the Arc Tangent function.

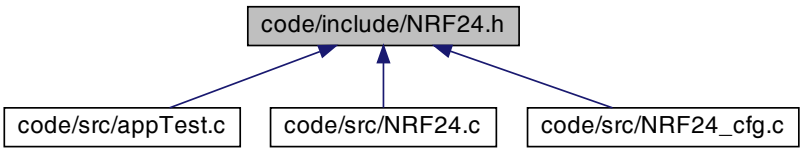
It has a maximum error of 0.18 radians.

Definition at line 286 of file MATH.h.

## 5.22 code/include/NRF24.h File Reference

Interfaces header file for NRF24.c.

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




### Functions

- void NRF24_Init (void)
- void NRF24_TxMode (void)
- void NRF24_SendString (u8 *data, u8 length)
- void NRF24_RxMode (void)
- u8 NRF24_Available (void)
- ERROR_STATUS_t NRF24_ReceiveString (u8 *data, u8 length)

### 5.22.1 Detailed Description

Interfaces header file for NRF24.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**



### 5.22.2 Function Documentation

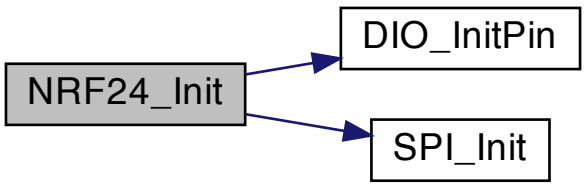
#### 5.22.2.1 NRF24_Available() u8 NRF24_Available ( void )

Definition at line 307 of file NRF24.c.

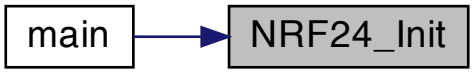
#### 5.22.2.2 NRF24_Init() void NRF24_Init ( void )

Definition at line 155 of file NRF24.c.

Here is the call graph for this function:



Here is the caller graph for this function:




#### 5.22.2.3 NRF24_ReceiveString()

```
ERROR_STATUS_t NRF24_ReceiveString (
        u8 * data,
        u8 length )
```

Definition at line 328 of file NRF24.c.

#### 5.22.2.4 NRF24_RxMode()

```
void NRF24_RxMode (
        void  )
```

Definition at line 249 of file NRF24.c.

#### 5.22.2.5 NRF24_SendString()

```
void NRF24_SendString (
        u8 * data,
        u8 length )
```

Definition at line 214 of file NRF24.c.

#### 5.22.2.6 NRF24_TxMode()

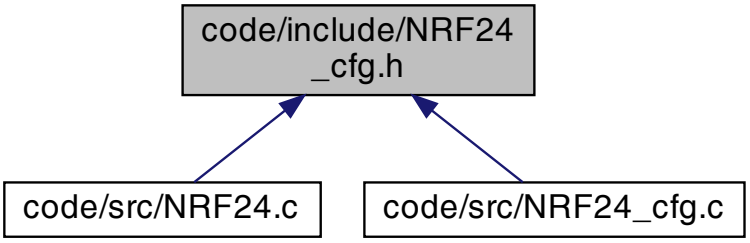
```
void NRF24_TxMode (
        void  )
```

Definition at line 191 of file NRF24.c.

## 5.23 code/include/NRF24_cfg.h File Reference

Configuration header file for NRF24.c.

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




### Data Structures

- struct CONNECTIONS_t
- struct PINS_t
- struct NRF24_t

### Enumerations

- enum PIPE_t {
  RX_PIPE0 , RX_PIPE1 , RX_PIPE2 , RX_PIPE3 ,
  RX_PIPE4 , RX_PIPE5 }

### Variables

- NRF24_t NRF24_cfg

### 5.23.1 Detailed Description

Configuration header file for NRF24.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

Copyright (c) 2022

### 5.23.2 Enumeration Type Documentation

#### 5.23.2.1 PIPE_t `enum PIPE_t`

**Enumerator**

| | |
|---|---|
| RX_PIPE0 | |
| RX_PIPE1 | |
| RX_PIPE2 | |
| RX_PIPE3 | |
| RX_PIPE4 | |
| RX_PIPE5 | |

Definition at line 23 of file NRF24_cfg.h.

### 5.23.3 Variable Documentation

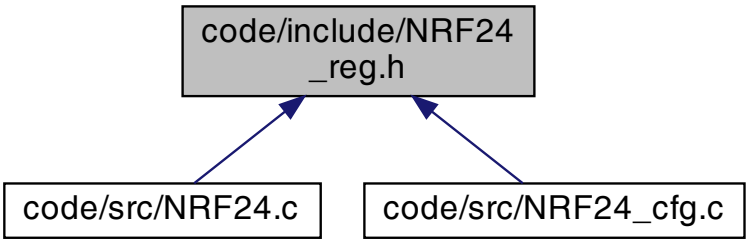
#### 5.23.3.1 NRF24_cfg `NRF24_t NRF24_cfg [extern]`

Definition at line 19 of file NRF24_cfg.c.

## 5.24 code/include/NRF24_reg.h File Reference

Registers of NRF24L01 wireless transceiver module.

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



### Macros

- #define CONFIG 0x00
- #define EN_AA 0x01
- #define EN_RXADDR 0x02
- #define SETUP_AW 0x03
- #define SETUP_RETR 0x04
- #define RF_CH 0x05
- #define RF_SETUP 0x06
- #define STATUS 0x07
- #define OBSERVE_TX 0x08
- #define CD 0x09
- #define RX_ADDR_P0 0x0A

  *Pipes 0-5 addressses.*
- #define RX_ADDR_P1 0x0B
- #define RX_ADDR_P2 0x0C
- #define RX_ADDR_P3 0x0D
- #define RX_ADDR_P4 0x0E
- #define RX_ADDR_P5 0x0F
- #define TX_ADDR 0x10

  *Transmit address.*
- #define RX_PW_P0 ( (u8)0x11 )

  *RX payload widths of pipes 0-5: 0 - 32 bytes.*
- #define RX_PW_P1 ( (u8)0x12 )
- #define RX_PW_P2 ( (u8)0x13 )
- #define RX_PW_P3 ( (u8)0x14 )
- #define RX_PW_P4 ( (u8)0x15 )
- #define RX_PW_P5 ( (u8)0x16 )
- #define FIFO_STATUS ( (u8)0x17 )
- #define DYNPD ( (u8)0x1C )
- #define FEATURE ( (u8)0x1D )
- #define R_REGISTER ( (u8)0x00U ) /∗ Read command ∗/
- #define W_REGISTER ( (u8)0x20U ) /∗ Write command ∗/
- #define R_RX_PAYLOAD ( (u8)0x61U ) /∗ Read RX payload ∗/
- #define W_TX_PAYLOAD ( (u8)0xA0U ) /∗ Write TX payload ∗/
- #define FLUSH_TX ( (u8)0xE1U ) /∗ Flush TX FIFO ∗/
- #define FLUSH_RX ( (u8)0xE2U ) /∗ Flush RX FIFO ∗/
- #define REUSE_TX_PL ( (u8)0xE3U ) /∗ Reuse last transmitted payload ∗/
- #define R_RX_PL_WID ( (u8)0x60U ) /∗ Read RX payload width for the top RX payload in the FIFO ∗/
- #define W_ACK_PAYLOAD ( (u8)0xA8U ) /∗ Write Payload to be transmitted together with ACK ∗/
- #define W_TX_PAYLOAD_NOACK ( (u8)0xB0U ) /∗ Write Payload to be transmitted without ACK ∗/
- #define NOP ( (u8)0xFF ) /∗ No operation ∗/
- #define ACTIVATE ( (u8)0x50U ) /∗ Activate features ∗/
- #define REGISTER_MASK ( (u8)0x1FU ) /∗ Register mask ∗/

### Enumerations

- enum {
  PRIM_RX , PWR_UP , CRCO , EN_CRC ,
  MASK_MAX_RT , MASK_TX_DS , MASK_RX_DR }
- enum {
  ENAA_P0 , ENAA_P1 , ENAA_P2 , ENAA_P3 ,
  ENAA_P4 , ENAA_P5 }

- enum {
  ERX_P0 , ERX_P1 , ERX_P2 , ERX_P3 ,
  ERX_P4 , ERX_P5 }
- enum { AW0 , AW1 }
- enum {
  ARC0 , ARC1 , ARC2 , ARC3 ,
  ARD0 , ARD1 , ARD2 , ARD3 }
- enum {
  RF_CH0 , RF_CH1 , RF_CH2 , RF_CH3 ,
  RF_CH4 , RF_CH5 , RF_CH6 }
- enum {
  Obsolete , RF_PWR0 , RF_PWR1 , RF_DR_HIGH ,
  PLL_LOCK , RF_DR_LOW , RESERVED , CONT_WAVE }
- enum {
  TX_FULL0 , RX_P_NO0 , RX_P_NO1 , RX_P_NO2 ,
  MAX_RT , TX_DS , RX_DR }
- enum {
  ARC_CNT0 , ARC_CNT1 , ARC_CNT2 , ARC_CNT3 ,
  PLOS_CNT0 , PLOS_CNT1 , PLOS_CNT2 , PLOS_CNT3 }
- enum { RPD }
- enum {
  RX_EMPTY , RX_FULL1 , TX_EMPTY = 4 , TX_FULL ,
  TX_REUSE }
- enum {
  DYNPD0 , DYNPD1 , DYNPD2 , DYNPD3 ,
  DYNPD4 , DYNPD5 }
- enum { EN_DYN_ACK , EN_ACK_PAY , EN_DPL }
- enum {
  DPL_P0 , DPL_P1 , DPL_P2 , DPL_P3 ,
  DPL_P4 , DPL_P5 }

### 5.24.1 Detailed Description

Registers of NRF24L01 wireless transceiver module.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2021-07-31

### 5.24.2 Macro Definition Documentation

#### 5.24.2.1 ACTIVATE `#define ACTIVATE ( (u8)0x50U ) /* Activate features */`

Definition at line 192 of file NRF24_reg.h.

#### 5.24.2.2 CD `#define CD 0x09`

Definition at line 146 of file NRF24_reg.h.

#### 5.24.2.3 CONFIG `#define CONFIG 0x00`

Definition at line 137 of file NRF24_reg.h.

#### 5.24.2.4 DYNPD `#define DYNPD ( (u8)0x1C )`

Definition at line 174 of file NRF24_reg.h.

#### 5.24.2.5 EN_AA `#define EN_AA 0x01`

Definition at line 138 of file NRF24_reg.h.

#### 5.24.2.6 EN_RXADDR `#define EN_RXADDR 0x02`

Definition at line 139 of file NRF24_reg.h.

#### 5.24.2.7 FEATURE `#define FEATURE ( (u8)0x1D )`

Definition at line 175 of file NRF24_reg.h.

#### 5.24.2.8 FIFO_STATUS `#define FIFO_STATUS ( (u8)0x17 )`

Definition at line 173 of file NRF24_reg.h.

#### 5.24.2.9 FLUSH_RX `#define FLUSH_RX ( (u8)0xE2U ) /* Flush RX FIFO */`

Definition at line 185 of file NRF24_reg.h.

#### 5.24.2.10 FLUSH_TX `#define FLUSH_TX ( (u8)0xE1U ) /* Flush TX FIFO */`

Definition at line 184 of file NRF24_reg.h.

#### 5.24.2.11 NOP `#define NOP ( (u8)0xFF ) /* No operation */`

Definition at line 190 of file NRF24_reg.h.

#### 5.24.2.12 OBSERVE_TX `#define OBSERVE_TX 0x08`

Definition at line 145 of file NRF24_reg.h.

#### 5.24.2.13 R_REGISTER `#define R_REGISTER ( (u8)0x00U ) /* Read command */`

Definition at line 180 of file NRF24_reg.h.

#### 5.24.2.14 R_RX_PAYLOAD `#define R_RX_PAYLOAD ( (u8)0x61U ) /* Read RX payload */`

Definition at line 182 of file NRF24_reg.h.

#### 5.24.2.15 R_RX_PL_WID `#define R_RX_PL_WID ( (u8)0x60U ) /* Read RX payload width for the top RX payload in the FIFO */`

Definition at line 187 of file NRF24_reg.h.

#### 5.24.2.16 REGISTER_MASK `#define REGISTER_MASK ( (u8)0x1FU ) /* Register mask */`

Definition at line 193 of file NRF24_reg.h.

#### 5.24.2.17 REUSE_TX_PL `#define REUSE_TX_PL ( (u8)0xE3U ) /* Reuse last transmitted payload */`

Definition at line 186 of file NRF24_reg.h.

#### 5.24.2.18 RF_CH `#define RF_CH 0x05`

Definition at line 142 of file NRF24_reg.h.

#### 5.24.2.19 RF_SETUP `#define RF_SETUP 0x06`

Definition at line 143 of file NRF24_reg.h.

#### 5.24.2.20 RX_ADDR_P0 `#define RX_ADDR_P0 0x0A`

Pipes 0-5 addressses.

Definition at line 151 of file NRF24_reg.h.

#### 5.24.2.21 RX_ADDR_P1 `#define RX_ADDR_P1 0x0B`

Definition at line 152 of file NRF24_reg.h.

#### 5.24.2.22 RX_ADDR_P2 `#define RX_ADDR_P2 0x0C`

Definition at line 153 of file NRF24_reg.h.

#### 5.24.2.23 RX_ADDR_P3 `#define RX_ADDR_P3 0x0D`

Definition at line 154 of file NRF24_reg.h.

#### 5.24.2.24 RX_ADDR_P4 `#define RX_ADDR_P4 0x0E`

Definition at line 155 of file NRF24_reg.h.

#### 5.24.2.25 RX_ADDR_P5 `#define RX_ADDR_P5 0x0F`

Definition at line 156 of file NRF24_reg.h.

#### 5.24.2.26 RX_PW_P0 `#define RX_PW_P0 ( (u8)0x11 )`

RX payload widths of pipes 0-5: 0 - 32 bytes.

Definition at line 166 of file NRF24_reg.h.

#### 5.24.2.27 RX_PW_P1 `#define RX_PW_P1 ( (u8)0x12 )`

Definition at line 167 of file NRF24_reg.h.

#### 5.24.2.28 RX_PW_P2 `#define RX_PW_P2 ( (u8)0x13 )`

Definition at line 168 of file NRF24_reg.h.

#### 5.24.2.29 RX_PW_P3 `#define RX_PW_P3 ( (u8)0x14 )`

Definition at line 169 of file NRF24_reg.h.

#### 5.24.2.30 RX_PW_P4 `#define RX_PW_P4 ( (u8)0x15 )`

Definition at line 170 of file NRF24_reg.h.

#### 5.24.2.31 RX_PW_P5 `#define RX_PW_P5 ( (u8)0x16 )`

Definition at line 171 of file NRF24_reg.h.

#### 5.24.2.32 SETUP_AW `#define SETUP_AW 0x03`

Definition at line 140 of file NRF24_reg.h.

#### 5.24.2.33 SETUP_RETR `#define SETUP_RETR 0x04`

Definition at line 141 of file NRF24_reg.h.

#### 5.24.2.34 STATUS `#define STATUS 0x07`

Definition at line 144 of file NRF24_reg.h.

#### 5.24.2.35 TX_ADDR `#define TX_ADDR 0x10`

Transmit address.

Definition at line 161 of file NRF24_reg.h.

#### 5.24.2.36 W_ACK_PAYLOAD `#define W_ACK_PAYLOAD ( (u8)0xA8U ) /* Write Payload to be transmitted together with ACK */`

Definition at line 188 of file NRF24_reg.h.

#### 5.24.2.37 W_REGISTER `#define W_REGISTER ( (u8)0x20U ) /* Write command */`

Definition at line 181 of file NRF24_reg.h.

#### 5.24.2.38 W_TX_PAYLOAD `#define W_TX_PAYLOAD ( (u8)0xA0U ) /* Write TX payload */`

Definition at line 183 of file NRF24_reg.h.

#### 5.24.2.39 W_TX_PAYLOAD_NOACK `#define W_TX_PAYLOAD_NOACK ( (u8)0xB0U ) /* Write Payload to be transmitted without ACK */`

Definition at line 189 of file NRF24_reg.h.

### 5.24.3 Enumeration Type Documentation

#### 5.24.3.1 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| RF_CH0 | |
| RF_CH1 | |
| RF_CH2 | |
| RF_CH3 | |
| RF_CH4 | |
| RF_CH5 | |
| RF_CH6 | |

Definition at line 55 of file NRF24_reg.h.

#### 5.24.3.2 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| Obsolete | |
| RF_PWR0 | |
| RF_PWR1 | |
| RF_DR_HIGH | |
| PLL_LOCK | |
| RF_DR_LOW | |
| RESERVED | |
| CONT_WAVE | |

Definition at line 65 of file NRF24_reg.h.

#### 5.24.3.3 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| TX_FULL0 | |
| RX_P_NO0 | |
| RX_P_NO1 | |
| RX_P_NO2 | |
| MAX_RT | |
| TX_DS | |
| RX_DR | |

Definition at line 76 of file NRF24_reg.h.

#### 5.24.3.4 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| ARC_CNT0 | |
| ARC_CNT1 | |
| ARC_CNT2 | |
| ARC_CNT3 | |
| PLOS_CNT0 | |
| PLOS_CNT1 | |
| PLOS_CNT2 | |
| PLOS_CNT3 | |

Definition at line 86 of file NRF24_reg.h.

#### 5.24.3.5 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| RPD | |

Definition at line 97 of file NRF24_reg.h.

#### 5.24.3.6 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| RX_EMPTY | |
| RX_FULL1 | |
| TX_EMPTY | |
| TX_FULL | |
| TX_REUSE | |

Definition at line 101 of file NRF24_reg.h.

#### 5.24.3.7 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| DYNPD0 | |
| DYNPD1 | |
| DYNPD2 | |
| DYNPD3 | |
| DYNPD4 | |
| DYNPD5 | |

Definition at line 109 of file NRF24_reg.h.

#### 5.24.3.8 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| EN_DYN_ACK | |
| EN_ACK_PAY | |
| EN_DPL | |

Definition at line 118 of file NRF24_reg.h.

#### 5.24.3.9 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| DPL_P0 | |
| DPL_P1 | |
| DPL_P2 | |
| DPL_P3 | |
| DPL_P4 | |
| DPL_P5 | |

Definition at line 125 of file NRF24_reg.h.

#### 5.24.3.10 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| PRIM_RX | |
| PWR_UP | |
| CRCO | |
| EN_CRC | |
| MASK_MAX_RT | |
| MASK_TX_DS | |
| MASK_RX_DR | |

Definition at line 11 of file NRF24_reg.h.

#### 5.24.3.11 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| ENAA_P0 | |
| ENAA_P1 | |
| ENAA_P2 | |
| ENAA_P3 | |
| ENAA_P4 | |
| ENAA_P5 | |

Definition at line 21 of file NRF24_reg.h.

#### 5.24.3.12 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| ERX_P0 | |
| ERX_P1 | |
| ERX_P2 | |
| ERX_P3 | |
| ERX_P4 | |
| ERX_P5 | |

Definition at line 30 of file NRF24_reg.h.

#### 5.24.3.13 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| AW0 | |
| AW1 | |

Definition at line 39 of file NRF24_reg.h.

#### 5.24.3.14 anonymous enum `anonymous enum`

**Enumerator**

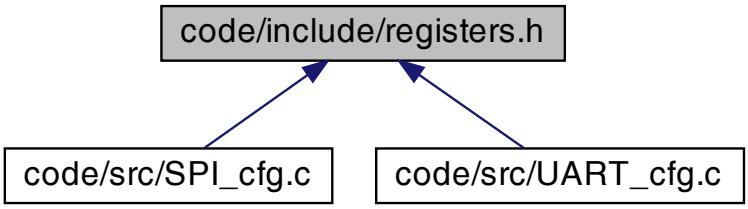
| | |
|---|---|
| ARC0 | |
| ARC1 | |
| ARC2 | |
| ARC3 | |
| ARD0 | |
| ARD1 | |
| ARD2 | |
| ARD3 | |

Definition at line 44 of file NRF24_reg.h.

## 5.25 code/include/registers.h File Reference

Registers of ATmega328p MCU.

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




### Macros

- #define ADC_u8ADMUX_REG (∗ ((volatile u8 ∗) 0x27) )
- #define ADC_u8ADCSRA_REG (∗ ((volatile u8 ∗) 0x26) )
- #define ADC_u8ADCH_REG (∗ ((volatile u8 ∗) 0x25) )
- #define ADC_u8ADCL_REG (∗ ((volatile u8 ∗) 0x24) )
- #define ADC_u8ADCSRB_REG (∗ ((volatile u8 ∗) 0x06) )
- #define EEPROM_u8EECR_REG (∗ ((volatile u8 ∗) 0x3F) )
- #define EEPROM_u8EEDR_REG (∗ ((volatile u8 ∗) 0x3E) )
- #define EEPROM_u8EEARL_REG (∗ ((volatile u8 ∗) 0x3D) )
- #define EEPROM_u8EEARH_REG (∗ ((volatile u8 ∗) 0x3C) )
- #define EEPROM_u8EECR_REG (∗ ((volatile u8 ∗) 0x3F) )

### 5.25.1 Detailed Description

Registers of ATmega328p MCU.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2021-07-31

### 5.25.2 Macro Definition Documentation

#### 5.25.2.1 ADC_u8ADCH_REG

```
#define ADC_u8ADCH_REG (* ((volatile u8 *) 0x25) )
```

Definition at line 16 of file registers.h.

#### 5.25.2.2 ADC_u8ADCL_REG

```
#define ADC_u8ADCL_REG (* ((volatile u8 *) 0x24) )
```

Definition at line 17 of file registers.h.

#### 5.25.2.3 ADC_u8ADCSRA_REG

```
#define ADC_u8ADCSRA_REG (* ((volatile u8 *) 0x26) )
```

Definition at line 15 of file registers.h.

#### 5.25.2.4 ADC_u8ADCSRB_REG

```
#define ADC_u8ADCSRB_REG (* ((volatile u8 *) 0x06) )
```

Definition at line 18 of file registers.h.

#### 5.25.2.5 ADC_u8ADMUX_REG

```
#define ADC_u8ADMUX_REG (* ((volatile u8 *) 0x27) )
```

ADC Register

Definition at line 14 of file registers.h.

#### 5.25.2.6 EEPROM_u8EEARH_REG

```
#define EEPROM_u8EEARH_REG (* ((volatile u8 *) 0x3C) )
```

Definition at line 26 of file registers.h.

#### 5.25.2.7 EEPROM_u8EEARL_REG

```
#define EEPROM_u8EEARL_REG (* ((volatile u8 *) 0x3D) )
```

Definition at line 25 of file registers.h.

#### 5.25.2.8 EEPROM_u8EECR_REG [1/2] #define EEPROM_u8EECR_REG (* ((volatile u8 *) 0x3F) )

EEPROM Register

Definition at line 27 of file registers.h.

#### 5.25.2.9 EEPROM_u8EECR_REG [2/2] #define EEPROM_u8EECR_REG (* ((volatile u8 *) 0x3F) )

EEPROM Register

Definition at line 27 of file registers.h.

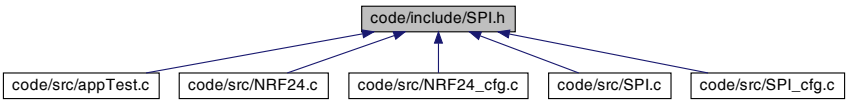
#### 5.25.2.10 EEPROM_u8EEDR_REG #define EEPROM_u8EEDR_REG (* ((volatile u8 *) 0x3E) )

Definition at line 24 of file registers.h.

## 5.26 code/include/SPI.h File Reference

Interfaces header file for SPI.c.

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




### Functions

- void SPI_Init (void)
- void SPI_EnableInterrupt (void(*ptrCallback)(void))
- void SPI_DisableInterrupt (void)
- ERROR_STATUS_t SPI_SendByte (const u8 data)
- ERROR_STATUS_t SPI_SendString (const u8 *str, u8 length)
- ERROR_STATUS_t SPI_ReceiveByte (u8 *const data)
- ERROR_STATUS_t SPI_ReceiveString (u8 *const str, u8 length)
- void SPI_TrancieveByte (const u8 dataToSend, u8 *const dataReceived)

### 5.26.1 Detailed Description

Interfaces header file for SPI.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

Copyright (c) 2022

### 5.26.2 Function Documentation

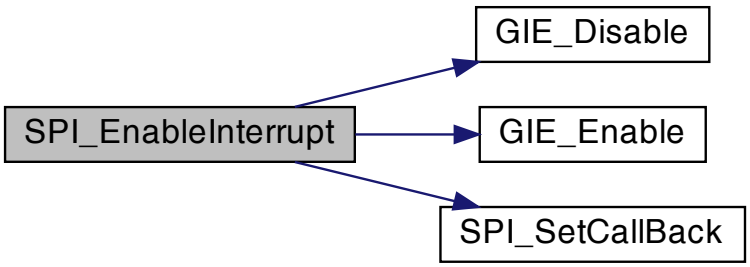
#### 5.26.2.1 SPI_DisableInterrupt() `void SPI_DisableInterrupt ( void )`

Definition at line 238 of file SPI.c.

#### 5.26.2.2 SPI_EnableInterrupt() `void SPI_EnableInterrupt ( void(*)(void) ptrCallback )`

Definition at line 229 of file SPI.c.

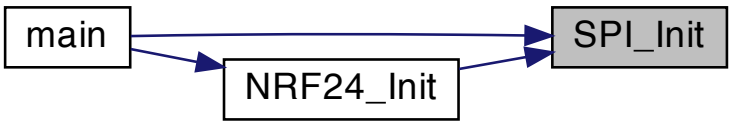
Here is the call graph for this function:



#### 5.26.2.3 SPI_Init() `void SPI_Init (`
`void )`

Definition at line 212 of file SPI.c.

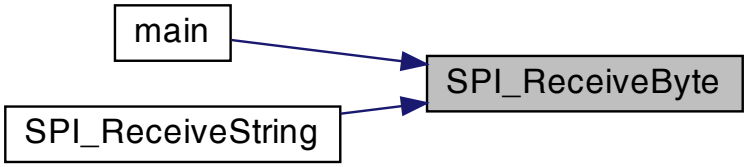
Here is the caller graph for this function:




#### 5.26.2.4 SPI_ReceiveByte() `ERROR_STATUS_t SPI_ReceiveByte (`
`u8 *const data )`

Definition at line 273 of file SPI.c.

Here is the caller graph for this function:




#### 5.26.2.5 SPI_ReceiveString() `ERROR_STATUS_t SPI_ReceiveString (`
`u8 *const str,`
`u8 length )`

Definition at line 293 of file SPI.c.

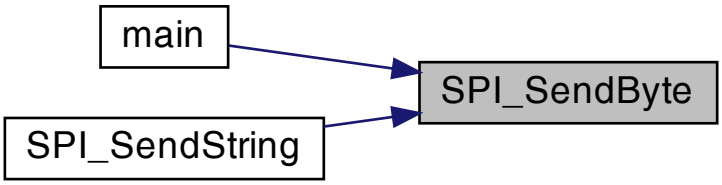
Here is the call graph for this function:


#### 5.26.2.6 SPI_SendByte()

```
ERROR_STATUS_t SPI_SendByte (
        const u8 data )
```

Definition at line 242 of file SPI.c.

Here is the caller graph for this function:




#### 5.26.2.7 SPI_SendString()

```
ERROR_STATUS_t SPI_SendString (
        const u8 * str,
        u8 length )
```

Definition at line 258 of file SPI.c.

Here is the call graph for this function:

#### 5.26.2.8 SPI_TrancieveByte()

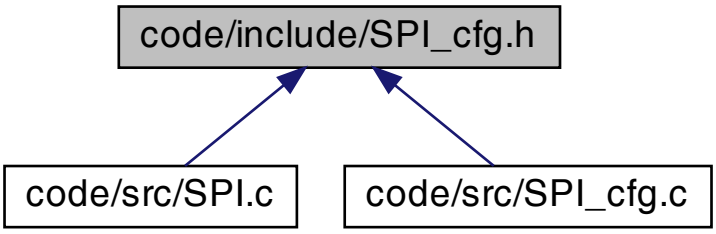
```
void SPI_TrancieveByte (
        const u8 dataToSend,
        u8 *const dataReceived )
```

Definition at line 285 of file SPI.c.

## 5.27 code/include/SPI_cfg.h File Reference

Configuration header file for SPI.c.

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




### Data Structures

- struct SPI_PINS_t
- struct SPI_CONNECTIONS_t
- struct SPI_CONFIG_t

### Enumerations

- enum SPI_MODE_t { SPI_MASTER , SPI_SLAVE }
- enum SPI_DATA_ORDER_t { SPI_DATA_ORDER_LSB_FIRST , SPI_DATA_ORDER_MSB_FIRST }
- enum SPI_CLOCK_MODE_t { SPI_MODE0 , SPI_MODE1 , SPI_MODE2 , SPI_MODE3 }
- enum SPI_PRESCALER_t {
  SPI_PRESCALER_2 , SPI_PRESCALER_4 , SPI_PRESCALER_8 , SPI_PRESCALER_16 ,
  SPI_PRESCALER_32 , SPI_PRESCALER_64 , SPI_PRESCALER_128 }
- enum SPI_DOUBLE_SPEED_t { SPI_DOUBLE_SPEED_DISABLE , SPI_DOUBLE_SPEED_ENABLE }

### Variables

- SPI_CONFIG_t SPI_Config

### 5.27.1 Detailed Description

Configuration header file for SPI.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

Copyright (c) 2022

### 5.27.2 Enumeration Type Documentation

#### 5.27.2.1 SPI_CLOCK_MODE_t enum SPI_CLOCK_MODE_t

**Enumerator**

| | |
|---|---|
| SPI_MODE0 | |
| SPI_MODE1 | |
| SPI_MODE2 | |
| SPI_MODE3 | |

Definition at line 22 of file SPI_cfg.h.

#### 5.27.2.2 SPI_DATA_ORDER_t enum SPI_DATA_ORDER_t

**Enumerator**

| | |
|---|---|
| SPI_DATA_ORDER_LSB_FIRST | |
| SPI_DATA_ORDER_MSB_FIRST | |

Definition at line 17 of file SPI_cfg.h.

#### 5.27.2.3 SPI_DOUBLE_SPEED_t enum SPI_DOUBLE_SPEED_t

**Enumerator**

| | |
|---|---|
| SPI_DOUBLE_SPEED_DISABLE | |
| SPI_DOUBLE_SPEED_ENABLE | |

Definition at line 39 of file SPI_cfg.h.

#### 5.27.2.4 SPI_MODE_t enum SPI_MODE_t

**Enumerator**

| | |
|---|---|
| SPI_MASTER | |
| SPI_SLAVE | |

Definition at line 12 of file SPI_cfg.h.

#### 5.27.2.5 SPI_PRESCALER_t enum SPI_PRESCALER_t

**Enumerator**

| | |
|---|---|
| SPI_PRESCALER_2 | |
| SPI_PRESCALER_4 | |
| SPI_PRESCALER_8 | |
| SPI_PRESCALER_16 | |
| SPI_PRESCALER_32 | |
| SPI_PRESCALER_64 | |
| SPI_PRESCALER_128 | |

Definition at line 29 of file SPI_cfg.h.

### 5.27.3 Variable Documentation

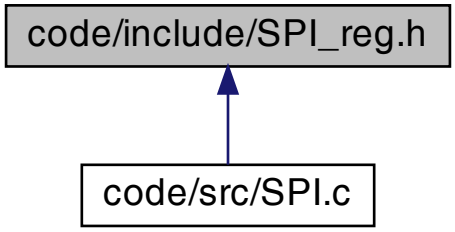
#### 5.27.3.1 SPI_Config SPI_CONFIG_t SPI_Config [extern]

Definition at line 17 of file SPI_cfg.c.

## 5.28 code/include/SPI_reg.h File Reference

SPI Registers of ATmega328p MCU.

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




### Macros

- #define SPCR (∗ ((volatile u8 ∗) 0x2D) )
- #define SPSR (∗ ((volatile u8 ∗) 0x2E) )
- #define SPDR (∗ ((volatile u8 ∗) 0x2F) )

### Enumerations

- enum {
  SPR0 , SPR1 , CPHA , CPOL ,
  MSTR , DORD , SPE , SPIE }
- enum { SPI2X , WCOL = 6 , SPIF }

### 5.28.1 Detailed Description

SPI Registers of ATmega328p MCU.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2021-07-31

### 5.28.2 Macro Definition Documentation

#### 5.28.2.1 SPCR `#define SPCR (* ((volatile u8 *) 0x2D) )`

Definition at line 11 of file SPI_reg.h.

#### 5.28.2.2 SPDR `#define SPDR (* ((volatile u8 *) 0x2F) )`

Definition at line 13 of file SPI_reg.h.

#### 5.28.2.3 SPSR `#define SPSR (* ((volatile u8 *) 0x2E) )`

Definition at line 12 of file SPI_reg.h.

### 5.28.3 Enumeration Type Documentation

#### 5.28.3.1 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| SPR0 | |
| SPR1 | |
| CPHA | |
| CPOL | |
| MSTR | |
| DORD | |
| SPE | |
| SPIE | |

Definition at line 16 of file SPI_reg.h.

#### 5.28.3.2 anonymous enum `anonymous enum`

**Enumerator**

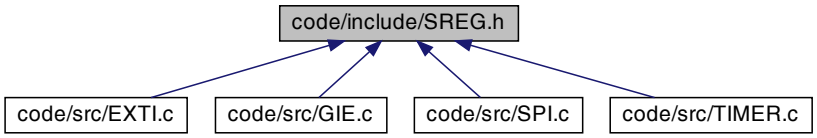
| | |
|---|---|
| SPI2X | |
| WCOL | |
| SPIF | |

Definition at line 27 of file SPI_reg.h.

## 5.29 code/include/SREG.h File Reference

Status Registers of ATmega328p MCU.

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




### Macros

- #define SREG (∗ ((volatile u8 ∗) 0x5F) )

### Enumerations

- enum {
  C_BIT , Z_BIT , N_BIT , V_BIT ,
  S_BIT , H_BIT , T_BIT , I_BIT }

### 5.29.1 Detailed Description

Status Registers of ATmega328p MCU.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2021-07-31

### 5.29.2 Macro Definition Documentation

#### 5.29.2.1 SREG `#define SREG (* ((volatile u8 *) 0x5F) )`

Definition at line 11 of file SREG.h.

### 5.29.3 Enumeration Type Documentation

#### 5.29.3.1 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| C_BIT | |
| Z_BIT | |
| N_BIT | |
| V_BIT | |
| S_BIT | |
| H_BIT | |
| T_BIT | |
| I_BIT | |

Definition at line 13 of file SREG.h.

## 5.30 code/include/STD_TYPES.h File Reference

Standard data types For AVR Microcontrollers.

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

### Macros

- #define NULL ((void *)0)
- #define NULL_BYTE ('\0')

### Typedefs

- typedef signed long long int s64
- typedef signed long int s32
- typedef signed short int s16
- typedef signed char s8
- typedef unsigned long long int u64
- typedef unsigned long int u32
- typedef unsigned short int u16
- typedef unsigned char u8
- typedef float f32
- typedef double f64
- typedef u16 size_t

### Enumerations

- enum STATE_t { LOW , HIGH , NORMAL }
- enum ACTIVATION_STATUS_t { ACTIVE_LOW , ACTIVE_HIGH }
- enum BOOL_t { FALSE , TRUE }
- enum ERROR_STATUS_t { ERROR_YES , ERROR_NO , ERROR_TIMEOUT }

### 5.30.1 Detailed Description

Standard data types For AVR Microcontrollers.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Date**

2022-03-20

**Version**

1.0.0

### 5.30.2 Macro Definition Documentation

#### 5.30.2.1 NULL `#define NULL ((void *)0)`

NULL pointer

Definition at line 58 of file STD_TYPES.h.

#### 5.30.2.2 NULL_BYTE `#define NULL_BYTE ('\0')`

Definition at line 61 of file STD_TYPES.h.

### 5.30.3 Typedef Documentation

#### 5.30.3.1 f32 `typedef float f32`

Definition at line 24 of file STD_TYPES.h.

#### 5.30.3.2 f64 `typedef double f64`

Definition at line 25 of file STD_TYPES.h.

#### 5.30.3.3 s16 typedef signed short int s16

Definition at line 14 of file STD_TYPES.h.

#### 5.30.3.4 s32 typedef signed long int s32

Definition at line 13 of file STD_TYPES.h.

#### 5.30.3.5 s64 typedef signed long long int s64

Definition at line 12 of file STD_TYPES.h.

#### 5.30.3.6 s8 typedef signed char s8

Definition at line 15 of file STD_TYPES.h.

#### 5.30.3.7 size_t typedef u16 size_t

< This is a macro defined in the C standard library <stddef.h> for the size_t type size_t is an unsigned integer type of the result of the sizeof operator

Definition at line 29 of file STD_TYPES.h.

#### 5.30.3.8 u16 typedef unsigned short int u16

Definition at line 20 of file STD_TYPES.h.

#### 5.30.3.9 u32 typedef unsigned long int u32

Definition at line 19 of file STD_TYPES.h.

#### 5.30.3.10 u64 typedef unsigned long long int u64

Definition at line 18 of file STD_TYPES.h.

#### 5.30.3.11 u8 typedef unsigned char u8

Definition at line 21 of file STD_TYPES.h.

### 5.30.4 Enumeration Type Documentation

#### 5.30.4.1 ACTIVATION_STATUS_t enum ACTIVATION_STATUS_t

**Enumerator**

| | |
|---|---|
| ACTIVE_LOW | Active low means that the pin is pulled low when the pin is set to high |
| ACTIVE_HIGH | Active high means that the pin is pulled high when the pin is set to low |

Definition at line 39 of file STD_TYPES.h.

#### 5.30.4.2 BOOL_t `enum BOOL_t`

**Enumerator**

| | |
|---|---|
| FALSE | |
| TRUE | |

Definition at line 45 of file STD_TYPES.h.

#### 5.30.4.3 ERROR_STATUS_t `enum ERROR_STATUS_t`

**Enumerator**

| | |
|---|---|
| ERROR_YES | Error occured |
| ERROR_NO | No error occured |
| ERROR_TIMEOUT | Timeout occured |

Definition at line 50 of file STD_TYPES.h.

#### 5.30.4.4 STATE_t `enum STATE_t`

**Enumerator**

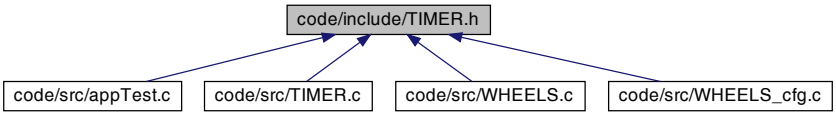
| | |
|---|---|
| LOW | |
| HIGH | |
| NORMAL | |

Definition at line 33 of file STD_TYPES.h.

## 5.31 code/include/TIMER.h File Reference

Interfaces header file for TIMER.c.

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




### Enumerations

- enum TIMER_CLOCK_t {
  NO_CLOCK , F_CPU_CLOCK , F_CPU_8 , F_CPU_32 ,
  F_CPU_64 , F_CPU_128 , F_CPU_256 , F_CPU_1024 ,
  F_CPU_EXT_CLK_FALLING , F_CPU_EXT_CLK_RISING }
- enum TIMER_MODE_t {
  TIMER_MODE_NORMAL , TIMER_MODE_CTC , TIMER_MODE_CTC_OCR , TIMER_MODE_CTC_ICR ,
  TIMER_MODE_FAST_PWM , TIMER_MODE_FAST_PWM_8 , TIMER_MODE_FAST_PWM_9 , TIMER_MODE_FAST_PWM_
  ,
  TIMER_MODE_FAST_PWM_ICR , TIMER_MODE_FAST_PWM_OCR , TIMER_MODE_PHASE_CORRECT_PWM
  , TIMER_MODE_PHASE_CORRECT_PWM_8 ,
  TIMER_MODE_PHASE_CORRECT_PWM_9 , TIMER_MODE_PHASE_CORRECT_PWM_10 , TIMER_MODE_PHASE_COR
  , TIMER_MODE_PHASE_CORRECT_PWM_OCR ,
  TIMER_MODE_PHASE_FREQ_CORRECT_ICR , TIMER_MODE_PHASE_FREQ_CORRECT_OCR }
- enum TIMER_OC_t { NO_OC , TOGGLE_OC , CLEAR_OC , SET_OC }
- enum TIMER_OCx_t { TIMER_OCA , TIMER_OCB , TIMER_OCC }
- enum PWM_t {
  PWM_0 , PWM_1 , PWM_2 , PWM_3 ,
  PWM_4 , PWM_5 , PWM_6 , PWM_7 }

### Functions

- void TIMER0_Init (u8 initValue, TIMER_CLOCK_t clock, TIMER_MODE_t timerMode, TIMER_OC_t compareMode)
- void TIMER0_SetCompareValue (u8 u8CompareValue)
- void TIMER0_SetTimer (u8 u8TimerValue)
- void TIMER0_EnableOverflowInterrupt (void(∗callBackPtr)(void))
- void TIMER0_DisableOverflowInterrupt (void)
- void TIMER0_EnableCompareMatchInterrupt (void(∗callBackPtr)(void))
- void TIMER0_DisableCompareMatchInterrupt (void)
- u8 TIMER0_GetTimerValue (void)
- void PWM_Init (PWM_t channel, u32 frequency)
- void PWM_Write (PWM_t channel, u8 dutyPercentage)
- void TIMER1_Init (u16 initValue, TIMER_CLOCK_t clock, TIMER_MODE_t timerMode, TIMER_OC_t compareMode, TIMER_OCx_t OCx)
- void TIMER1_SetCompareValue (u16 u16CompareValue, TIMER_OCx_t OCx)
- void TIMER1_SetTimer (u16 u16TimerValue)
- void TIMER1_EnableOverflowInterrupt (void(∗callBackPtr)(void))
- void TIMER1_DisableOverflowInterrupt (void)
- void TIMER1_EnableCompareMatchInterrupt (TIMER_OCx_t OCx, void(∗callBackPtr)(void))
- void TIMER1_DisableCompareMatchInterrupt (TIMER_OCx_t OCx)
- void TIMER1_EnableCaptureInterrupt (void(∗callBackPtr)(void))
- void TIMER1_DisableCaptureInterrupt (void)
- u16 TIMER1_GetTimerValue (void)

### 5.31.1 Detailed Description

Interfaces header file for TIMER.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**



### 5.31.2 Enumeration Type Documentation

#### 5.31.2.1 PWM_t enum PWM_t

**Enumerator**

| | |
|---|---|
| PWM_0 | |
| PWM_1 | |
| PWM_2 | |
| PWM_3 | |
| PWM_4 | |
| PWM_5 | |
| PWM_6 | |
| PWM_7 | |

Definition at line 63 of file TIMER.h.

#### 5.31.2.2 TIMER_CLOCK_t enum TIMER_CLOCK_t

**Enumerator**

| | |
|---|---|
| NO_CLOCK | |
| F_CPU_CLOCK | |
| F_CPU_8 | |
| F_CPU_32 | |
| F_CPU_64 | |
| F_CPU_128 | |
| F_CPU_256 | |
| F_CPU_1024 | |
| F_CPU_EXT_CLK_FALLING | |
| F_CPU_EXT_CLK_RISING | |

Definition at line 16 of file TIMER.h.

#### 5.31.2.3 TIMER_MODE_t enum TIMER_MODE_t

**Enumerator**

| | |
|---|---|
| TIMER_MODE_NORMAL | |
| TIMER_MODE_CTC | |
| TIMER_MODE_CTC_OCR | |
| TIMER_MODE_CTC_ICR | |
| TIMER_MODE_FAST_PWM | |
| TIMER_MODE_FAST_PWM_8 | |
| TIMER_MODE_FAST_PWM_9 | |
| TIMER_MODE_FAST_PWM_10 | |
| TIMER_MODE_FAST_PWM_ICR | |
| TIMER_MODE_FAST_PWM_OCR | |
| TIMER_MODE_PHASE_CORRECT_PWM | |
| TIMER_MODE_PHASE_CORRECT_PWM_8 | |
| TIMER_MODE_PHASE_CORRECT_PWM_9 | |
| TIMER_MODE_PHASE_CORRECT_PWM_10 | |
| TIMER_MODE_PHASE_CORRECT_PWM_ICR | |
| TIMER_MODE_PHASE_CORRECT_PWM_OCR | |
| TIMER_MODE_PHASE_FREQ_CORRECT_ICR | |
| TIMER_MODE_PHASE_FREQ_CORRECT_OCR | |

Definition at line 29 of file TIMER.h.

#### 5.31.2.4 TIMER_OC_t enum TIMER_OC_t

**Enumerator**

| | |
|---|---|
| NO_OC | |
| TOGGLE_OC | |
| CLEAR_OC | |
| SET_OC | |

Definition at line 50 of file TIMER.h.

#### 5.31.2.5 TIMER_OCx_t `enum TIMER_OCx_t`

**Enumerator**

| | |
|---|---|
| TIMER_OCA | |
| TIMER_OCB | |
| TIMER_OCC | |

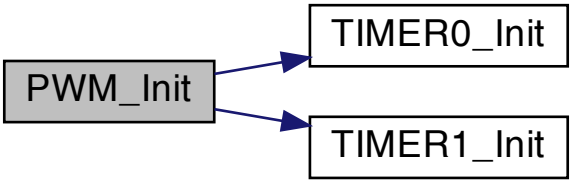
Definition at line 57 of file TIMER.h.

### 5.31.3 Function Documentation

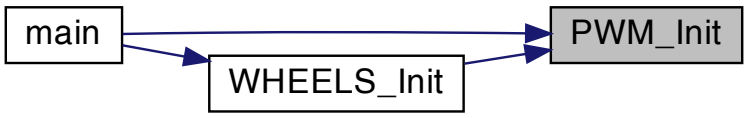
#### 5.31.3.1 PWM_Init() `void PWM_Init ( PWM_t channel, u32 frequency )`

Definition at line 755 of file TIMER.c.

Here is the call graph for this function:




Here is the caller graph for this function:

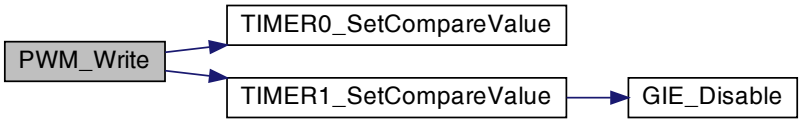


#### 5.31.3.2 PWM_Write() `void PWM_Write (`

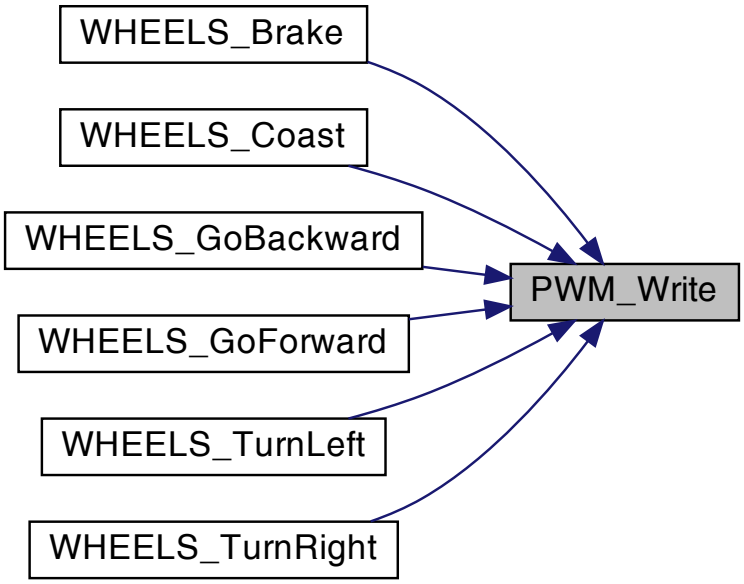
```
PWM_t channel,
u8 dutyPercentage )
```

Definition at line 793 of file TIMER.c.

Here is the call graph for this function:




Here is the caller graph for this function:




#### 5.31.3.3 TIMER0_DisableCompareMatchInterrupt() `void TIMER0_DisableCompareMatchInterrupt (`

```
void )
```

Definition at line 565 of file TIMER.c.

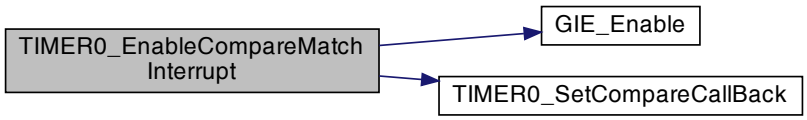
#### 5.31.3.4 TIMER0_DisableOverflowInterrupt() void TIMER0_DisableOverflowInterrupt ( void )

Definition at line 550 of file TIMER.c.

#### 5.31.3.5 TIMER0_EnableCompareMatchInterrupt() void TIMER0_EnableCompareMatchInterrupt ( void(*)(void) *callBackPtr* )

Definition at line 555 of file TIMER.c.

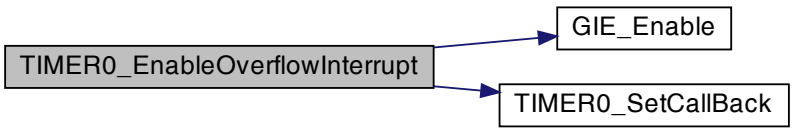
Here is the call graph for this function:




#### 5.31.3.6 TIMER0_EnableOverflowInterrupt() void TIMER0_EnableOverflowInterrupt ( void(*)(void) *callBackPtr* )

Definition at line 540 of file TIMER.c.

Here is the call graph for this function:




#### 5.31.3.7 TIMER0_GetTimerValue() u8 TIMER0_GetTimerValue ( void )

Definition at line 570 of file TIMER.c.

#### 5.31.3.8 TIMER0_Init() `void TIMER0_Init (`

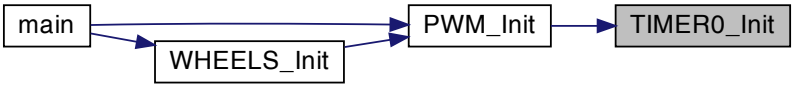
```
u8 initValue,
TIMER_CLOCK_t clock,
TIMER_MODE_t timerMode,
TIMER_OC_t compareMode )
```

Prototypes of Timer 0 functions

TIMER0 Implementations

Definition at line 518 of file TIMER.c.

Here is the caller graph for this function:

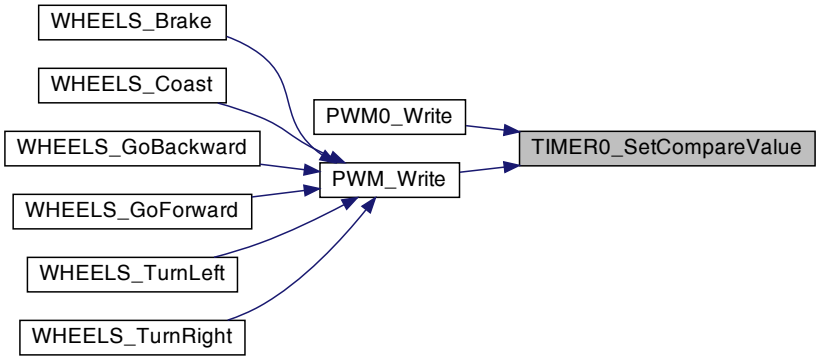



#### 5.31.3.9 TIMER0_SetCompareValue() `void TIMER0_SetCompareValue (`

```
u8 u8CompareValue )
```

Definition at line 532 of file TIMER.c.

Here is the caller graph for this function:




#### 5.31.3.10 TIMER0_SetTimer() `void TIMER0_SetTimer (`

```
u8 u8TimerValue )
```

Definition at line 536 of file TIMER.c.

#### 5.31.3.11 TIMER1_DisableCaptureInterrupt() `void TIMER1_DisableCaptureInterrupt ( void )`

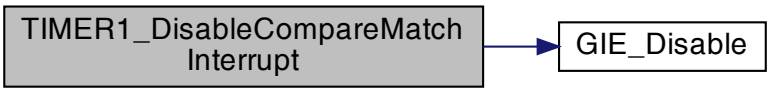
Definition at line 724 of file TIMER.c.

Here is the call graph for this function:


#### 5.31.3.12 TIMER1_DisableCompareMatchInterrupt() `void TIMER1_DisableCompareMatchInterrupt ( TIMER_OCx_t OCx )`

Definition at line 692 of file TIMER.c.

Here is the call graph for this function:




#### 5.31.3.13 TIMER1_DisableOverflowInterrupt() `void TIMER1_DisableOverflowInterrupt ( void )`

Definition at line 659 of file TIMER.c.

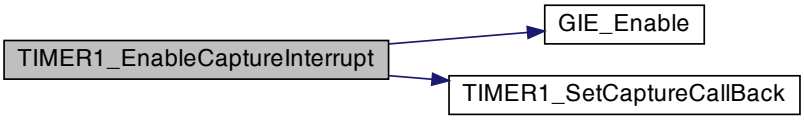
Here is the call graph for this function:

#### 5.31.3.14 TIMER1_EnableCaptureInterrupt() `void TIMER1_EnableCaptureInterrupt (`

```
void(*)(void) callBackPtr )
```

Definition at line 714 of file TIMER.c.

Here is the call graph for this function:

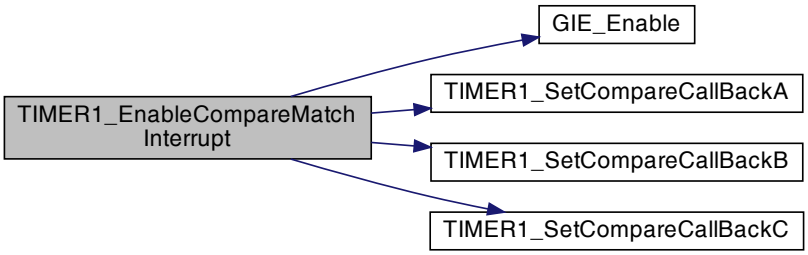



#### 5.31.3.15 TIMER1_EnableCompareMatchInterrupt() `void TIMER1_EnableCompareMatchInterrupt (`

```
TIMER_OCx_t OCx,
void(*)(void) callBackPtr )
```

Definition at line 670 of file TIMER.c.

Here is the call graph for this function:

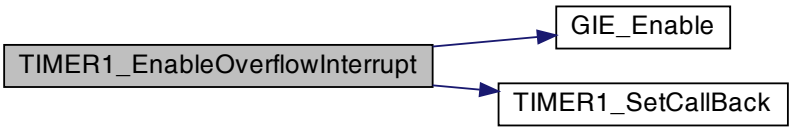



#### 5.31.3.16 TIMER1_EnableOverflowInterrupt() `void TIMER1_EnableOverflowInterrupt (`

```
void(*)(void) callBackPtr )
```

Definition at line 649 of file TIMER.c.

Here is the call graph for this function:



#### 5.31.3.17 TIMER1_GetTimerValue() u16 TIMER1_GetTimerValue ( void )

Definition at line 735 of file TIMER.c.

Here is the call graph for this function:

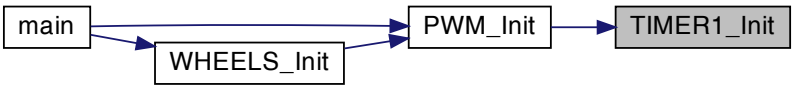

#### 5.31.3.18 TIMER1_Init() void TIMER1_Init ( u16 *initValue*, TIMER_CLOCK_t *clock*, TIMER_MODE_t *timerMode*, TIMER_OC_t *compareMode*, TIMER_OCx_t *OCx* )

Prototypes of Timer 1 functions

TIMER1 Implementations

Definition at line 585 of file TIMER.c.

Here is the caller graph for this function:

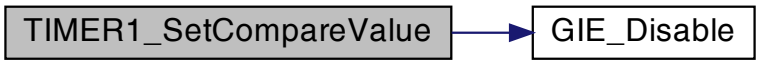


#### 5.31.3.19 TIMER1_SetCompareValue() `void TIMER1_SetCompareValue (`

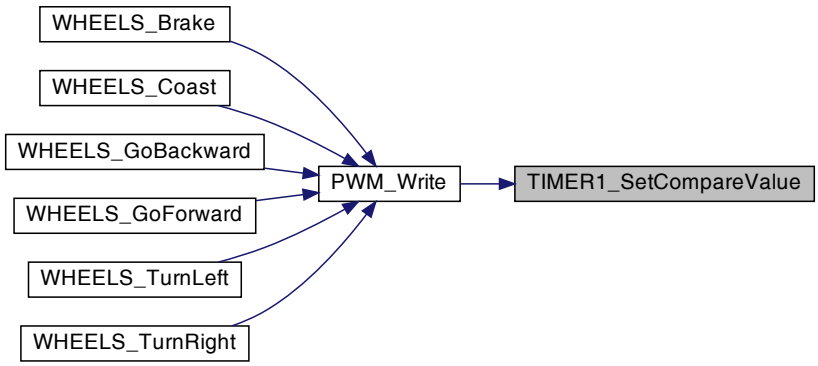
```
u16 u16CompareValue,
TIMER_OCx_t OCx )
```

Definition at line 613 of file TIMER.c.

Here is the call graph for this function:




Here is the caller graph for this function:

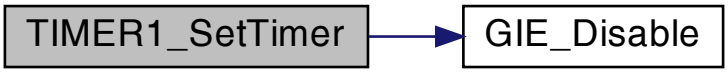



#### 5.31.3.20 TIMER1_SetTimer() `void TIMER1_SetTimer (`

```
u16 u16TimerValue )
```

Definition at line 638 of file TIMER.c.

Here is the call graph for this function:



## 5.32 code/include/TIMER_cfg.h File Reference

Configuration header file for TIMER.c.

### 5.32.1 Detailed Description

Configuration header file for TIMER.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

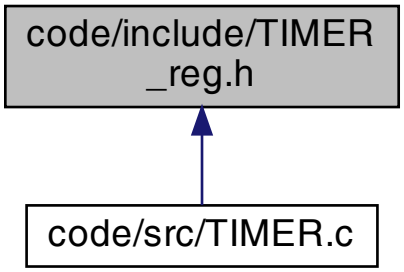
**Copyright**

Copyright (c) 2022

## 5.33 code/include/TIMER_reg.h File Reference

Registers of Timers of ATmega328p MCU.

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



### Macros

- #define TCCR0 (∗ ((volatile u8 ∗) 0x53) ) /∗ Timer/Counter Control Register A ∗/
- #define TCNT0 (∗ ((volatile u8 ∗) 0x52) ) /∗ Time Counter ∗/
- #define OCR0 (∗ ((volatile u8 ∗) 0x51) ) /∗ Output Compare Register ∗/
- #define ASSR (∗ ((volatile u8 ∗) 0x50) ) /∗ Asynchronous Status Register ∗/
- #define TCCR1A (∗ ((volatile u8 ∗) 0x4F) )
- #define TCCR1B (∗ ((volatile u8 ∗) 0x4E) )
- #define TCCR1C (∗ ((volatile u8 ∗) 0x7A) )
- #define TCNT1H (∗ ((volatile u8 ∗) 0x4D) )
- #define TCNT1L (∗ ((volatile u8 ∗) 0x4C) )
- #define ICR1H (∗ ((volatile u8 ∗) 0x47) )
- #define ICR1L (∗ ((volatile u8 ∗) 0x46) )
- #define OCR1AH (∗ ((volatile u8 ∗) 0x4B) )
- #define OCR1AL (∗ ((volatile u8 ∗) 0x4A) )
- #define OCR1BH (∗ ((volatile u8 ∗) 0x49) )
- #define OCR1BL (∗ ((volatile u8 ∗) 0x48) )
- #define OCR1CH (∗ ((volatile u8 ∗) 0x79) )
- #define OCR1CL (∗ ((volatile u8 ∗) 0x78) )
- #define TCCR2 (∗ ((volatile u8 ∗) 0x45) )
- #define TCNT2 (∗ ((volatile u8 ∗) 0x44) )
- #define OCR2 (∗ ((volatile u8 ∗) 0x43) )
- #define TCCR3A (∗ ((volatile u8 ∗) 0x8B) )
- #define TCCR3B (∗ ((volatile u8 ∗) 0x8A) )
- #define TCCR3C (∗ ((volatile u8 ∗) 0x8C) )
- #define TCNT3H (∗ ((volatile u8 ∗) 0x89) )
- #define TCNT3L (∗ ((volatile u8 ∗) 0x88) )
- #define ICR3H (∗ ((volatile u8 ∗) 0x81) )
- #define ICR3L (∗ ((volatile u8 ∗) 0x80) )
- #define OCR3AH (∗ ((volatile u8 ∗) 0x87) )
- #define OCR3AL (∗ ((volatile u8 ∗) 0x86) )
- #define OCR3BH (∗ ((volatile u8 ∗) 0x85) )
- #define OCR3BL (∗ ((volatile u8 ∗) 0x84) )
- #define OCR3CH (∗ ((volatile u8 ∗) 0x83) )
- #define OCR3CL (∗ ((volatile u8 ∗) 0x82) )
- #define TIMER_u8TIMSK_REG (∗ ((volatile u8 ∗) 0x57) )
- #define TIMER_u8TIFR_REG (∗ ((volatile u8 ∗) 0x56) )
- #define TIMER_u8ETIMSK_REG (∗ ((volatile u8 ∗) 0x7D) )
- #define TIMER_u8ETIFR_REG (∗ ((volatile u8 ∗) 0x7C) )

### Enumerations

- enum {
  CS00 , CS01 , CS02 , WGM01 ,
  COM00 , COM01 , WGM00 , FOC0 }
- enum { TCR0UB , OCR0UB , TCN0UB , AS0 }
- enum {
  WGM10 , WGM11 , COM1C0 , COM1C1 ,
  COM1B0 , COM1B1 , COM1A0 , COM1A1 }
- enum {
  CS10 , CS11 , CS12 , WGM12 ,
  WGM13 , ICES1 = 6 , ICNC1 }
- enum { FOC1C = 5 , FOC1B , FOC1A }

- enum {
  CS20 , CS21 , CS22 , WGM21 ,
  COM20 , COM21 , WGM20 , FOC2 }
- enum {
  WGM30 , WGM31 , COM3C0 , COM3C1 ,
  COM3B0 , COM3B1 , COM3A0 , COM3A1 }
- enum {
  CS30 , CS31 , CS32 , WGM32 ,
  WGM33 , ICES3 = 6 , ICNC3 }
- enum { FOC3C = 5 , FOC3B , FOC3A }
- enum {
  TOIE0 , OCIE0 , TOIE1 , OCIE1B ,
  OCIE1A , TICIE1 , TOIE2 , OCIE2 }
- enum {
  OCIE1C , OCIE3C , TOIE3 , OCIE3B ,
  OCIE3A , TICIE3 }
- enum {
  TOV0 , OCF0 , TOV1 , OCF1B ,
  OCF1A , ICF1 , TOV2 , OCF2 }
- enum {
  OCF1C , OCF3C , TOV3 , OCF3B ,
  OCF3A , ICF3 }

### 5.33.1 Detailed Description

Registers of Timers of ATmega328p MCU.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2021-07-31

### 5.33.2 Macro Definition Documentation

#### 5.33.2.1 ASSR `#define ASSR (* ((volatile u8 *) 0x50) ) /* Asynchronous Status Register */`

Definition at line 17 of file TIMER_reg.h.

#### 5.33.2.2 ICR1H `#define ICR1H (* ((volatile u8 *) 0x47) )`

Definition at line 45 of file TIMER_reg.h.

#### 5.33.2.3 ICR1L `#define ICR1L (* ((volatile u8 *) 0x46) )`

Definition at line 46 of file TIMER_reg.h.

#### 5.33.2.4 ICR3H `#define ICR3H (* ((volatile u8 *) 0x81) )`

Definition at line 107 of file TIMER_reg.h.

#### 5.33.2.5 ICR3L `#define ICR3L (* ((volatile u8 *) 0x80) )`

Definition at line 108 of file TIMER_reg.h.

#### 5.33.2.6 OCR0 `#define OCR0 (* ((volatile u8 *) 0x51) ) /* Output Compare Register */`

Definition at line 16 of file TIMER_reg.h.

#### 5.33.2.7 OCR1AH `#define OCR1AH (* ((volatile u8 *) 0x4B) )`

Definition at line 47 of file TIMER_reg.h.

#### 5.33.2.8 OCR1AL `#define OCR1AL (* ((volatile u8 *) 0x4A) )`

Definition at line 48 of file TIMER_reg.h.

#### 5.33.2.9 OCR1BH `#define OCR1BH (* ((volatile u8 *) 0x49) )`

Definition at line 49 of file TIMER_reg.h.

#### 5.33.2.10 OCR1BL `#define OCR1BL (* ((volatile u8 *) 0x48) )`

Definition at line 50 of file TIMER_reg.h.

#### 5.33.2.11 OCR1CH `#define OCR1CH (* ((volatile u8 *) 0x79) )`

Definition at line 51 of file TIMER_reg.h.

#### 5.33.2.12 OCR1CL `#define OCR1CL (* ((volatile u8 *) 0x78) )`

Definition at line 52 of file TIMER_reg.h.

#### 5.33.2.13 OCR2 `#define OCR2 (* ((volatile u8 *) 0x43) )`

Definition at line 86 of file TIMER_reg.h.

#### 5.33.2.14 OCR3AH `#define OCR3AH (* ((volatile u8 *) 0x87) )`

Definition at line 109 of file TIMER_reg.h.

#### 5.33.2.15 OCR3AL `#define OCR3AL (* ((volatile u8 *) 0x86) )`

Definition at line 110 of file TIMER_reg.h.

#### 5.33.2.16 OCR3BH `#define OCR3BH (* ((volatile u8 *) 0x85) )`

Definition at line 111 of file TIMER_reg.h.

#### 5.33.2.17 OCR3BL `#define OCR3BL (* ((volatile u8 *) 0x84) )`

Definition at line 112 of file TIMER_reg.h.

#### 5.33.2.18 OCR3CH `#define OCR3CH (* ((volatile u8 *) 0x83) )`

Definition at line 113 of file TIMER_reg.h.

#### 5.33.2.19 OCR3CL `#define OCR3CL (* ((volatile u8 *) 0x82) )`

Definition at line 114 of file TIMER_reg.h.

#### 5.33.2.20 TCCR0 `#define TCCR0 (* ((volatile u8 *) 0x53) ) /* Timer/Counter Control Register A */`

Timer/Counter0 Register (8-bit)

Definition at line 14 of file TIMER_reg.h.

#### 5.33.2.21 TCCR1A `#define TCCR1A (* ((volatile u8 *) 0x4F) )`

Timer/Counter1 Register (16-bit)

Definition at line 40 of file TIMER_reg.h.

#### 5.33.2.22 TCCR1B `#define TCCR1B (* ((volatile u8 *) 0x4E) )`

Definition at line 41 of file TIMER_reg.h.

#### 5.33.2.23 TCCR1C `#define TCCR1C (* ((volatile u8 *) 0x7A) )`

Definition at line 42 of file TIMER_reg.h.

#### 5.33.2.24 TCCR2 `#define TCCR2 (* ((volatile u8 *) 0x45) )`

Timer/Counter2 Register (8-bit)

Definition at line 84 of file TIMER_reg.h.

#### 5.33.2.25 TCCR3A `#define TCCR3A (* ((volatile u8 *) 0x8B) )`

Timer/Counter3 Register (16-bit)

Definition at line 102 of file TIMER_reg.h.

#### 5.33.2.26 TCCR3B `#define TCCR3B (* ((volatile u8 *) 0x8A) )`

Definition at line 103 of file TIMER_reg.h.

#### 5.33.2.27 TCCR3C `#define TCCR3C (* ((volatile u8 *) 0x8C) )`

Definition at line 104 of file TIMER_reg.h.

#### 5.33.2.28 TCNT0 `#define TCNT0 (* ((volatile u8 *) 0x52) ) /* Time Counter */`

Definition at line 15 of file TIMER_reg.h.

#### 5.33.2.29 TCNT1H `#define TCNT1H (* ((volatile u8 *) 0x4D) )`

Definition at line 43 of file TIMER_reg.h.

#### 5.33.2.30 TCNT1L `#define TCNT1L (* ((volatile u8 *) 0x4C) )`

Definition at line 44 of file TIMER_reg.h.

#### 5.33.2.31 TCNT2 `#define TCNT2 (* ((volatile u8 *) 0x44) )`

Definition at line 85 of file TIMER_reg.h.

#### 5.33.2.32 TCNT3H `#define TCNT3H (* ((volatile u8 *) 0x89) )`

Definition at line 105 of file TIMER_reg.h.

#### 5.33.2.33 TCNT3L `#define TCNT3L (* ((volatile u8 *) 0x88) )`

Definition at line 106 of file TIMER_reg.h.

#### 5.33.2.34 TIMER_u8ETIFR_REG `#define TIMER_u8ETIFR_REG (* ((volatile u8 *) 0x7C) )`

Definition at line 149 of file TIMER_reg.h.

#### 5.33.2.35 TIMER_u8ETIMSK_REG `#define TIMER_u8ETIMSK_REG (* ((volatile u8 *) 0x7D) )`

Definition at line 148 of file TIMER_reg.h.

#### 5.33.2.36 TIMER_u8TIFR_REG `#define TIMER_u8TIFR_REG (* ((volatile u8 *) 0x56) )`

Definition at line 147 of file TIMER_reg.h.

#### 5.33.2.37 TIMER_u8TIMSK_REG `#define TIMER_u8TIMSK_REG (* ((volatile u8 *) 0x57) )`

Timers/Counters Common Registers

Definition at line 146 of file TIMER_reg.h.

### 5.33.3 Enumeration Type Documentation

#### 5.33.3.1 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| CS00 | |
| CS01 | |
| CS02 | |
| WGM01 | |
| COM00 | |
| COM01 | |
| WGM00 | |
| FOC0 | |

Definition at line 19 of file TIMER_reg.h.

#### 5.33.3.2 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| TCR0UB | |
| OCR0UB | |
| TCN0UB | |
| AS0 | |

Definition at line 30 of file TIMER_reg.h.

#### 5.33.3.3 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| WGM10 | |
| WGM11 | |
| COM1C0 | |
| COM1C1 | |
| COM1B0 | |
| COM1B1 | |
| COM1A0 | |
| COM1A1 | |

Definition at line 54 of file TIMER_reg.h.

#### 5.33.3.4 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| CS10 | |
| CS11 | |
| CS12 | |
| WGM12 | |
| WGM13 | |
| ICES1 | |
| ICNC1 | |

Definition at line 65 of file TIMER_reg.h.

#### 5.33.3.5 anonymous enum anonymous enum

**Enumerator**

| | |
|---|---|
| FOC1C | |
| FOC1B | |
| FOC1A | |

Definition at line 75 of file TIMER_reg.h.

#### 5.33.3.6 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| CS20 | |
| CS21 | |
| CS22 | |
| WGM21 | |
| COM20 | |
| COM21 | |
| WGM20 | |
| FOC2 | |

Definition at line 88 of file TIMER_reg.h.

#### 5.33.3.7 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| WGM30 | |
| WGM31 | |
| COM3C0 | |
| COM3C1 | |
| COM3B0 | |
| COM3B1 | |
| COM3A0 | |
| COM3A1 | |

Definition at line 116 of file TIMER_reg.h.

#### 5.33.3.8 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| CS30 | |

**Enumerator**

| | |
|---|---|
| CS31 | |
| CS32 | |
| WGM32 | |
| WGM33 | |
| ICES3 | |
| ICNC3 | |

Definition at line 127 of file TIMER_reg.h.

#### 5.33.3.9 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| FOC3C | |
| FOC3B | |
| FOC3A | |

Definition at line 137 of file TIMER_reg.h.

#### 5.33.3.10 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| TOIE0 | |
| OCIE0 | |
| TOIE1 | |
| OCIE1B | |
| OCIE1A | |
| TICIE1 | |
| TOIE2 | |
| OCIE2 | |

Definition at line 151 of file TIMER_reg.h.

#### 5.33.3.11 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| OCIE1C | |
| OCIE3C | |
| TOIE3 | |

**Enumerator**

| | |
|---|---|
| OCIE3B | |
| OCIE3A | |
| TICIE3 | |

Definition at line 163 of file TIMER_reg.h.

#### 5.33.3.12 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| TOV0 | |
| OCF0 | |
| TOV1 | |
| OCF1B | |
| OCF1A | |
| ICF1 | |
| TOV2 | |
| OCF2 | |

Definition at line 172 of file TIMER_reg.h.

#### 5.33.3.13 anonymous enum `anonymous enum`

**Enumerator**

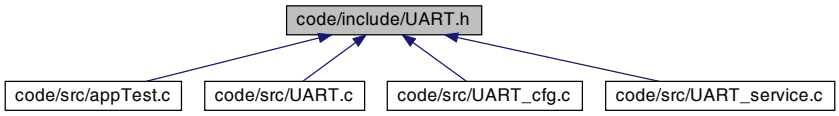
| | |
|---|---|
| OCF1C | |
| OCF3C | |
| TOV3 | |
| OCF3B | |
| OCF3A | |
| ICF3 | |

Definition at line 183 of file TIMER_reg.h.

## 5.34 code/include/UART.h File Reference

Interfaces header file for UART.c.

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




## Functions

- void UART0_Init (void)

  *Initialize UART module 0 as configured in UART_cfg.h and UART_cfg.c.*
- void UART1_Init (void)

  *Initialize UART module 1 as configured in UART_cfg.h and UART_cfg.c.*
- void UART0_Disable (void)

  *Disable UART module 0 if it is enabled.*
- void UART1_Disable (void)

  *Disable UART module 1 if it is enabled.*
- void UART0_Enable (void)

  *Enable UART module 0 if it is disabled previously by UART0_Disable()*
- void UART1_Enable (void)

  *Enable UART module 1 if it is disabled previously by UART1_Disable()*
- void UART0_SendByte (const u8 data)

  *Send a byte using UART module 0 Synchronously.*
- void UART0_SendByte_NoBlock (const u8 data)

  *Send a byte using UART module 0 Asynchronously.*
- void UART1_SendByte (const u8 data)

  *Send a byte using UART module 1.*
- void UART1_SendByte_NoBlock (const u8 data)

  *Send a byte using UART module 1 Asynchronously.*
- void UART0_Send9BitData (const u16 data)

  *Send 9 bits using UART module 0.*
- void UART0_Send9BitData_NoBlock (const u16 data)

  *Send 9 bits using UART module 0 Asynchronously.*
- void UART1_Send9BitData (const u16 data)

  *Send 9 bits using UART module 1.*
- void UART1_Send9BitData_NoBlock (const u16 data)

  *Send 9 bits using UART module 1 Asynchronously.*
- STATE_t UART0_Available (void)

  *Check if there is a byte available in UART module 0.*
- STATE_t UART1_Available (void)

  *Check if there is a byte available in UART module 1.*
- ERROR_STATUS_t UART0_ReceiveByte (u8 *data)

  *Receive a byte using UART module 0.*
- ERROR_STATUS_t UART0_ReceiveByte_NoBlock (u8 *data)

  *Receive a byte using UART module 0 Asynchronously.*
- ERROR_STATUS_t UART1_ReceiveByte (u8 *data)

  *Receive a byte using UART module 1.*
- ERROR_STATUS_t UART1_ReceiveByte_NoBlock (u8 *data)

*Receive a byte using UART module 1 Asynchronously.*

- ERROR_STATUS_t UART0_Receive9BitData (u16 *data)

  *Receive a string of 16 bits using UART module 0 (9 bits data)*
- ERROR_STATUS_t UART1_Receive9BitData (u16 *data)

  *Receive a string of 16 bits using UART module 1 (9 bits data)*
- void UART0_Flush (void)

  *Flush the receive buffer of UART module 0.*
- void UART1_Flush (void)

  *Flush the receive buffer of UART module 1.*
- void UART0_RX_InterruptEnable (void(*const ptrCallback)(void))

  *Enable the receive interrupt of UART module 0 with passing the function pointer to the interrupt service routine.*
- void UART1_RX_InterruptEnable (void(*const ptrCallback)(void))

  *Enable the receive interrupt of UART module 1 with passing the function pointer to the interrupt service routine.*
- void UART0_RX_InterruptDisable (void)

  *Disable the receive interrupt of UART module 0.*
- void UART1_RX_InterruptDisable (void)

  *Disable the receive interrupt of UART module 1.*
- void UART1_TX_InterruptEnable (void(*const ptrCallback)(void))

  *Enable the transmit interrupt of UART module 0 with passing the function pointer to the interrupt service routine.*
- void UART0_TX_InterruptEnable (void(*const ptrCallback)(void))

  *Enable the transmit interrupt of UART module 1 with passing the function pointer to the interrupt service routine.*
- void UART0_TX_InterruptDisable (void)

  *Disable the transmit interrupt of UART module 0.*
- void UART1_TX_InterruptDisable (void)

  *Disable the transmit interrupt of UART module 1.*
- void UART0_UDRE_InterruptEnable (void(*const ptrCallback)(void))

  *Enable the interrupt of Data Register Empty of UART module 0 with passing the function pointer to the interrupt service routine.*
- void UART1_UDRE_InterruptEnable (void(*const ptrCallback)(void))

  *Enable the interrupt of Data Register Empty of UART module 1 with passing the function pointer to the interrupt service routine.*
- void UART0_UDRE_InterruptDisable (void)

  *Disable the interrupt of Data Register Empty of UART module 0.*
- void UART1_UDRE_InterruptDisable (void)

  *Disable the interrupt of Data Register Empty of UART module 1.*

### 5.34.1 Detailed Description

Interfaces header file for UART.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-03

**Copyright**

### 5.34.2 Function Documentation

#### 5.34.2.1 UART0_Available() `STATE_t UART0_Available ( void )`

Check if there is a byte available in UART module 0.

**Returns**

HIGH if there is a byte available, LOW otherwise

Definition at line 625 of file UART.c.

Here is the caller graph for this function:


#### 5.34.2.2 UART0_Disable() `void UART0_Disable ( void )`

Disable UART module 0 if it is enabled.

Definition at line 546 of file UART.c.

#### 5.34.2.3 UART0_Enable() `void UART0_Enable ( void )`

Enable UART module 0 if it is disabled previously by UART0_Disable()

Definition at line 535 of file UART.c.

#### 5.34.2.4 UART0_Flush() `void UART0_Flush ( void )`

Flush the receive buffer of UART module 0.

**For Example: UART0_Flush(); will flush the receive buffer of UART module 0**

Flush the receive buffer of UART module 0.

Definition at line 640 of file UART.c.

#### 5.34.2.5 UART0_Init() `void UART0_Init ( void )`

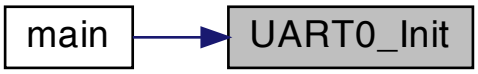
Initialize UART module 0 as configured in UART_cfg.h and UART_cfg.c.

**It configure UART module 0 accorfing to UART_cfg.h and UART_cfg.c**

and then enable UART module 0

Definition at line 482 of file UART.c.

Here is the caller graph for this function:




#### 5.34.2.6 UART0_Receive9BitData() `ERROR_STATUS_t UART0_Receive9BitData ( u16 * data )`

Receive a string of 16 bits using UART module 0 (9 bits data)

**For Example: UART0_Receive9BitString(string); will receive a string of 16 bits**

from UART module 0 and store it in variable <string>

**Returns**

The error code: ERROR_NO if no error, ERROR_YES if error

Definition at line 599 of file UART.c.

#### 5.34.2.7 UART0_ReceiveByte() `ERROR_STATUS_t UART0_ReceiveByte ( u8 * data )`

Receive a byte using UART module 0.

**For Example: UART0_ReceiveByte(&data); will receive a byte from UART module 0**

and store it in variable <data>

**Returns**

The error code: ERROR_NO if no error, ERROR_YES if error

Definition at line 591 of file UART.c.

Here is the caller graph for this function:


#### 5.34.2.8 UART0_ReceiveByte_NoBlock() `ERROR_STATUS_t UART0_ReceiveByte_NoBlock ( u8 * data )`

Receive a byte using UART module 0 Asynchronously.

**For Example: UART0_ReceiveByte(&data); will receive a byte from UART module 0**

and store it in variable <data> without checking receive complete flag and without blocking the calling thread

**Returns**

The error code: ERROR_NO if no error, ERROR_YES if error

Definition at line 608 of file UART.c.

#### 5.34.2.9 UART0_RX_InterruptDisable() `void UART0_RX_InterruptDisable ( void )`

Disable the receive interrupt of UART module 0.

**For Example: UART0_RX_InterruptDisable(); will disable the receive interrupt**

of UART module 0

Definition at line 714 of file UART.c.

#### 5.34.2.10 UART0_RX_InterruptEnable() `void UART0_RX_InterruptEnable ( void(*)(void) ptrCallback )`

Enable the receive interrupt of UART module 0 with passing the function pointer to the interrupt service routine.

**Parameters**

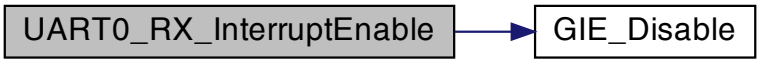
| | | |
|---|---|---|
| in | *ptrCallback* | Pointer to the interrupt service routine |

**Note**

The interrupt is triggered when a byte is received

Definition at line 648 of file UART.c.

Here is the call graph for this function:




#### 5.34.2.11 UART0_Send9BitData() `void UART0_Send9BitData ( const u16 data )`

Send 9 bits using UART module 0.

**For Example: UART0_Send9Bits(0x123); will send 9 bits 0x123 to UART module 0**

Definition at line 565 of file UART.c.

#### 5.34.2.12 UART0_Send9BitData_NoBlock() `void UART0_Send9BitData_NoBlock ( const u16 data )`

Send 9 bits using UART module 0 Asynchronously.

**For Example: UART0_Send9Bits_NoBlock(0x123); will send 9 bits 0x123 to UART module 0**

without blocking the calling thread

Definition at line 582 of file UART.c.

#### 5.34.2.13 UART0_SendByte() `void UART0_SendByte ( const u8 data )`

Send a byte using UART module 0 Synchronously.

**For Example: UART0_SendByte('a'); will send character 'a' to UART module 0**

Definition at line 557 of file UART.c.

Here is the caller graph for this function:


#### 5.34.2.14 UART0_SendByte_NoBlock() `void UART0_SendByte_NoBlock ( const u8 data )`

Send a byte using UART module 0 Asynchronously.

**For Example: UART0_SendByte_NoBlock('a'); will send character 'a' to UART module 0**

without blocking the calling thread

Definition at line 574 of file UART.c.

#### 5.34.2.15 UART0_TX_InterruptDisable() `void UART0_TX_InterruptDisable ( void )`

Disable the transmit interrupt of UART module 0.

**For Example: UART0_TX_InterruptDisable(); will disable the transmit interrupt**

of UART module 0

Definition at line 722 of file UART.c.

#### 5.34.2.16 UART0_TX_InterruptEnable() `void UART0_TX_InterruptEnable ( void(*)(void) ptrCallback )`

Enable the transmit interrupt of UART module 1 with passing the function pointer to the interrupt service routine.

**Parameters**

| | | |
|---|---|---|
| in | *ptrCallback* | Pointer to the interrupt service routine |

**Note**

The transmit interrupt will be triggered after transmission complete.

Definition at line 681 of file UART.c.

Here is the call graph for this function:


#### 5.34.2.17 UART0_UDRE_InterruptDisable() `void UART0_UDRE_InterruptDisable ( void )`

Disable the interrupt of Data Register Empty of UART module 0.

**For Example: UART0_UDRE_InterruptDisable(); will disable the interrupt**

of Data Register Empty of UART module 0

Definition at line 730 of file UART.c.

#### 5.34.2.18 UART0_UDRE_InterruptEnable() `void UART0_UDRE_InterruptEnable ( void(*)(void) ptrCallback )`

Enable the interrupt of Data Register Empty of UART module 0 with passing the function pointer to the interrupt service routine.

**Parameters**

| | | |
|---|---|---|
| in | *ptrCallback* | Pointer to the interrupt service routine |

**Note**

The interrupt is triggered when the data register is empty

Definition at line 692 of file UART.c.

Here is the call graph for this function:


#### 5.34.2.19 UART1_Available() `STATE_t UART1_Available ( void )`

Check if there is a byte available in UART module 1.

**Returns**

HIGH if there is a byte available, LOW otherwise

Definition at line 629 of file UART.c.

Here is the caller graph for this function:


#### 5.34.2.20 UART1_Disable() `void UART1_Disable ( void )`

Disable UART module 1 if it is enabled.

Definition at line 551 of file UART.c.

#### 5.34.2.21 UART1_Enable() `void UART1_Enable ( void )`

Enable UART module 1 if it is disabled previously by UART1_Disable()

**It enable UART module 1 if it is disabled previously by UART1_Disable()**

Definition at line 540 of file UART.c.

#### 5.34.2.22 UART1_Flush() `void UART1_Flush ( void )`

Flush the receive buffer of UART module 1.

**For Example: UART1_Flush(); will flush the receive buffer of UART module 1**

Definition at line 644 of file UART.c.

#### 5.34.2.23 UART1_Init() `void UART1_Init ( void )`

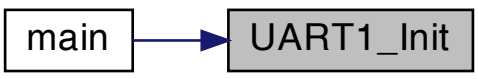
Initialize UART module 1 as configured in UART_cfg.h and UART_cfg.c.

**It configure UART module 1 accorfing to UART_cfg.h and UART_cfg.c**

and then enable UART module 1

Definition at line 508 of file UART.c.

Here is the caller graph for this function:



#### 5.34.2.24 UART1_Receive9BitData() ERROR_STATUS_t UART1_Receive9BitData ( u16 * data )

Receive a string of 16 bits using UART module 1 (9 bits data)

**For Example: UART1_Receive9BitString(string); will receive a string of 16 bits**

from UART module 1 and store it in variable <string>

**Returns**

The error code: ERROR_NO if no error, ERROR_YES if error

Definition at line 603 of file UART.c.

#### 5.34.2.25 UART1_ReceiveByte() ERROR_STATUS_t UART1_ReceiveByte ( u8 * data )

Receive a byte using UART module 1.

**For Example: UART1_ReceiveByte(&data); will receive a byte from UART module 1**

and store it in variable <data>

**Returns**

The error code: ERROR_NO if no error, ERROR_YES if error

Definition at line 595 of file UART.c.

Here is the caller graph for this function:

#### 5.34.2.26 UART1_ReceiveByte_NoBlock() `ERROR_STATUS_t UART1_ReceiveByte_NoBlock ( u8 * data )`

Receive a byte using UART module 1 Asynchronously.

**For Example: UART1_ReceiveByte(&data); will receive a byte from UART module 1**

and store it in variable <data> without checking receive complete flag and without blocking the calling thread

**Returns**

The error code: ERROR_NO if no error, ERROR_YES if error

Definition at line 612 of file UART.c.

#### 5.34.2.27 UART1_RX_InterruptDisable() `void UART1_RX_InterruptDisable ( void )`

Disable the receive interrupt of UART module 1.

**For Example: UART1_RX_InterruptDisable(); will disable the receive interrupt**

of UART module 1

Definition at line 718 of file UART.c.

#### 5.34.2.28 UART1_RX_InterruptEnable() `void UART1_RX_InterruptEnable ( void(*)(void) ptrCallback )`

Enable the receive interrupt of UART module 1 with passing the function pointer to the interrupt service routine.

**Parameters**

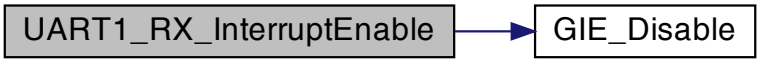
| | | |
|---|---|---|
| in | *ptrCallback* | Pointer to the interrupt service routine |

**Note**

The interrupt is triggered when a byte is received

Definition at line 659 of file UART.c.

Here is the call graph for this function:




#### 5.34.2.29 UART1_Send9BitData() `void UART1_Send9BitData ( const u16 data )`

Send 9 bits using UART module 1.

**Parameters**

| | | |
|---|---|---|
| in | *data* | 9 bits data to be sent. Should be between 0 and 0x1FF |

**Note**

Size of data should be 2 Bytes to be able to send 9 bits data

**For Example: UART1_Send9Bits(0x123); will send 9 bits 0x123 to UART module 1**

Definition at line 569 of file UART.c.

#### 5.34.2.30 UART1_Send9BitData_NoBlock() `void UART1_Send9BitData_NoBlock ( const u16 data )`

Send 9 bits using UART module 1 Asynchronously.

**Parameters**

| | | |
|---|---|---|
| in | *data* | 9 bits data to be sent. Should be between 0 and 0x1FF |

**Note**

Size of data should be 2 Bytes to be able to send 9 bits data

**For Example: UART1_Send9Bits_NoBlock(0x123); will send 9 bits 0x123 to UART module 1**

without blocking the calling thread

Definition at line 586 of file UART.c.

#### 5.34.2.31 UART1_SendByte() `void UART1_SendByte (`

```
const u8 data )
```

Send a byte using UART module 1.

**For Example: UART1_SendByte('y'); will send character 'y' to UART module 1**

Definition at line 561 of file UART.c.

Here is the caller graph for this function:


#### 5.34.2.32 UART1_SendByte_NoBlock() `void UART1_SendByte_NoBlock (`

```
const u8 data )
```

Send a byte using UART module 1 Asynchronously.

**For Example: UART1_SendByte_NoBlock('a'); will send character 'a' to UART module 1**

without blocking the calling thread

Definition at line 578 of file UART.c.

#### 5.34.2.33 UART1_TX_InterruptDisable() `void UART1_TX_InterruptDisable (`

```
void )
```

Disable the transmit interrupt of UART module 1.

**For Example: UART1_TX_InterruptDisable(); will disable the transmit interrupt**

of UART module 1

Definition at line 726 of file UART.c.

#### 5.34.2.34 UART1_TX_InterruptEnable() `void UART1_TX_InterruptEnable (`

```
void(*)(void) ptrCallback )
```

Enable the transmit interrupt of UART module 0 with passing the function pointer to the interrupt service routine.

**Parameters**

| | | |
|---|---|---|
| in | *ptrCallback* | Pointer to the interrupt service routine |

**Note**

The transmit interrupt will be triggered after transmission complete.

Definition at line 670 of file UART.c.

Here is the call graph for this function:


#### 5.34.2.35 UART1_UDRE_InterruptDisable() `void UART1_UDRE_InterruptDisable ( void )`

Disable the interrupt of Data Register Empty of UART module 1.

**For Example: UART1_UDRE_InterruptDisable(); will disable the interrupt**

of Data Register Empty of UART module 1

Definition at line 734 of file UART.c.

#### 5.34.2.36 UART1_UDRE_InterruptEnable() `void UART1_UDRE_InterruptEnable ( void(*)(void) ptrCallback )`

Enable the interrupt of Data Register Empty of UART module 1 with passing the function pointer to the interrupt service routine.

**Parameters**

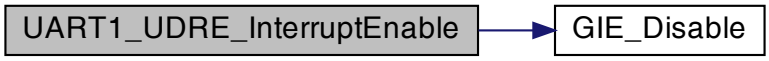
| | | |
|---|---|---|
| in | *ptrCallback* | Pointer to the interrupt service routine |

**Note**

The interrupt is triggered when the data register is empty

Definition at line 703 of file UART.c.

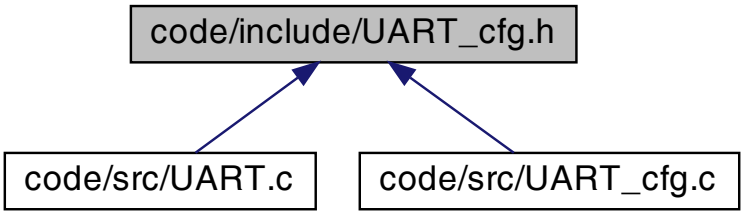
Here is the call graph for this function:




## 5.35 code/include/UART_cfg.h File Reference

Configuration header file for UART.c.

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




### Data Structures

- struct UART_CFG_t

### Macros

- #define UART_TIMEOUT_CYCLE_COUNT (16000)

### Enumerations

- enum UART_DATA_BITS_t { UART_DATA_5_BITS , UART_DATA_6_BITS , UART_DATA_7_BITS , UART_DATA_8_BITS , UART_DATA_9_BITS }
- enum UART_STOP_BITS_t { UART_STOP_1_BIT , UART_STOP_2_BIT }
- enum UART_PARITY_t { UART_PARITY_DISABLE , UART_PARITY_ODD , UART_PARITY_EVEN }
- enum UART_MODE_t { UART_MODE_ASYNCHRONOUS_NORMAL , UART_MODE_ASYNCHRONOUS_DOUBLE_SPEED , UART_MODE_SYNCHRONOUS_MASTER , UART_MODE_SYNCHRONOUS_SLAVE }
- enum UART_MODE_TYPE_t { UART_MODE_TX , UART_MODE_RX , UART_MODE_TX_RX }
- enum UART_CLOCK_POLARITY_t { UART_RISING_EDGE_CLOCK , UART_FALLING_EDGE_CLOCK }

### Variables

- UART_CFG_t UART0_Configs
- UART_CFG_t UART1_Configs

## 5.35.1 Detailed Description

Configuration header file for UART.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

Copyright (c) 2022

## 5.35.2 Macro Definition Documentation

### 5.35.2.1 UART_TIMEOUT_CYCLE_COUNT `#define UART_TIMEOUT_CYCLE_COUNT (16000)`

Definition at line 12 of file UART_cfg.h.

## 5.35.3 Enumeration Type Documentation

### 5.35.3.1 UART_CLOCK_POLARITY_t `enum UART_CLOCK_POLARITY_t`

**Enumerator**

| | |
|---|---|
| UART_RISING_EDGE_CLOCK | |
| UART_FALLING_EDGE_CLOCK | |

Definition at line 49 of file UART_cfg.h.

#### 5.35.3.2 UART_DATA_BITS_t enum UART_DATA_BITS_t

**Enumerator**

| | |
|---|---|
| UART_DATA_5_BITS | |
| UART_DATA_6_BITS | |
| UART_DATA_7_BITS | |
| UART_DATA_8_BITS | |
| UART_DATA_9_BITS | |

Definition at line 17 of file UART_cfg.h.

#### 5.35.3.3 UART_MODE_t enum UART_MODE_t

**Enumerator**

| | |
|---|---|
| UART_MODE_ASYNCHRONOUS_NORMAL | |
| UART_MODE_ASYNCHRONOUS_DOUBLE_SPEED | |
| UART_MODE_SYNCHRONOUS_MASTER | |
| UART_MODE_SYNCHRONOUS_SLAVE | |

Definition at line 36 of file UART_cfg.h.

#### 5.35.3.4 UART_MODE_TYPE_t enum UART_MODE_TYPE_t

**Enumerator**

| | |
|---|---|
| UART_MODE_TX | |
| UART_MODE_RX | |
| UART_MODE_TX_RX | |

Definition at line 43 of file UART_cfg.h.

#### 5.35.3.5 UART_PARITY_t enum UART_PARITY_t

**Enumerator**

| | |
|---|---|
| UART_PARITY_DISABLE | |
| UART_PARITY_ODD | |
| UART_PARITY_EVEN | |

Definition at line 30 of file UART_cfg.h.

#### 5.35.3.6 UART_STOP_BITS_t enum UART_STOP_BITS_t

**Enumerator**

| | |
|---|---|
| UART_STOP_1_BIT | |
| UART_STOP_2_BIT | |

Definition at line 25 of file UART_cfg.h.

### 5.35.4 Variable Documentation

#### 5.35.4.1 UART0_Configs UART_CFG_t UART0_Configs [extern]

**Note**

Baud rate options:

- 2400UL --> 2400 bits per second
- 4800UL --> 4800 bits per second
- 9600UL --> 9600 bits per second
- 14400UL --> 14400 bits per second
- 19200UL --> 19200 bits per second
- 28800UL --> 28800 bits per second
- 38400UL --> 38400 bits per second
- 57600UL --> 57600 bits per second
- 76800UL --> 76800 bits per second
- 115200UL --> 115200 bits per second
- 230400UL --> 230400 bits per second
- 250000UL --> 250000 bits per second
- 500000UL --> 500000 bits per second
- 1000000UL --> 1000000 bits per second

Definition at line 34 of file UART_cfg.c.

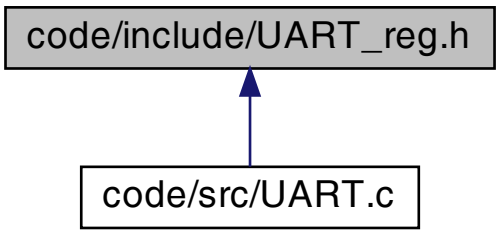
#### 5.35.4.2 UART1_Configs UART_CFG_t UART1_Configs [extern]

Definition at line 43 of file UART_cfg.c.

## 5.36 code/include/UART_reg.h File Reference

Registers of UART of ATmega328p MCU.

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




### Macros

- #define UDR0 (∗ ((volatile u8 ∗) 0x2C) )
- #define UCSR0A (∗ ((volatile u8 ∗) 0x2B) )
- #define UCSR0B (∗ ((volatile u8 ∗) 0x2A) )
- #define UCSR0C (∗ ((volatile u8 ∗) 0x95) )
- #define UBRR0L (∗ ((volatile u8 ∗) 0x29) )
- #define UBRR0H (∗ ((volatile u8 ∗) 0x90) )
- #define UDR1 (∗ ((volatile u8 ∗) 0x9C) )
- #define UCSR1A (∗ ((volatile u8 ∗) 0x9B) )
- #define UCSR1B (∗ ((volatile u8 ∗) 0x9A) )
- #define UCSR1C (∗ ((volatile u8 ∗) 0x9D) )
- #define UBRR1L (∗ ((volatile u8 ∗) 0x99) )
- #define UBRR1H (∗ ((volatile u8 ∗) 0x98) )

### Enumerations

- enum {
  MPCM , U2X , UPE , DOR ,
  FE , UDRE , TXC , RXC }
- enum {
  TXB8 , RXB8 , UCSZ2 , TXEN ,
  RXEN , UDRIE , TXCIE , RXCIE }
- enum {
  UCPOL , UCSZ0 , UCSZ1 , USBS ,
  UPM0 , UPM1 , UMSEL }

### 5.36.1 Detailed Description

Registers of UART of ATmega328p MCU.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2021-07-31

### 5.36.2 Macro Definition Documentation

#### 5.36.2.1 UBRR0H `#define UBRR0H (* ((volatile u8 *) 0x90) )`

Definition at line 19 of file UART_reg.h.

#### 5.36.2.2 UBRR0L `#define UBRR0L (* ((volatile u8 *) 0x29) )`

Definition at line 18 of file UART_reg.h.

#### 5.36.2.3 UBRR1H `#define UBRR1H (* ((volatile u8 *) 0x98) )`

Definition at line 29 of file UART_reg.h.

#### 5.36.2.4 UBRR1L `#define UBRR1L (* ((volatile u8 *) 0x99) )`

Definition at line 28 of file UART_reg.h.

#### 5.36.2.5 UCSR0A `#define UCSR0A (* ((volatile u8 *) 0x2B) )`

Definition at line 15 of file UART_reg.h.

#### 5.36.2.6 UCSR0B `#define UCSR0B (* ((volatile u8 *) 0x2A) )`

Definition at line 16 of file UART_reg.h.

#### 5.36.2.7 UCSR0C `#define UCSR0C (* ((volatile u8 *) 0x95) )`

Definition at line 17 of file UART_reg.h.

#### 5.36.2.8 UCSR1A `#define UCSR1A (* ((volatile u8 *) 0x9B) )`

Definition at line 25 of file UART_reg.h.

#### 5.36.2.9 UCSR1B `#define UCSR1B (* ((volatile u8 *) 0x9A) )`

Definition at line 26 of file UART_reg.h.

#### 5.36.2.10 UCSR1C `#define UCSR1C (* ((volatile u8 *) 0x9D) )`

Definition at line 27 of file UART_reg.h.

#### 5.36.2.11 UDR0 `#define UDR0 (* ((volatile u8 *) 0x2C) )`

UART0 Registers

Definition at line 14 of file UART_reg.h.

#### 5.36.2.12 UDR1 `#define UDR1 (* ((volatile u8 *) 0x9C) )`

UART1 Registers

Definition at line 24 of file UART_reg.h.

### 5.36.3 Enumeration Type Documentation

#### 5.36.3.1 anonymous enum `anonymous enum`

Registers' Bits

**Enumerator**

| | |
|---|---|
| MPCM | |
| U2X | |
| UPE | |
| DOR | |
| FE | |
| UDRE | |
| TXC | |
| RXC | |

Definition at line 34 of file UART_reg.h.

#### 5.36.3.2 anonymous enum `anonymous enum`

**Enumerator**

| | |
|---|---|
| TXB8 | |
| RXB8 | |
| UCSZ2 | |
| TXEN | |
| RXEN | |
| UDRIE | |
| TXCIE | |
| RXCIE | |

Definition at line 45 of file UART_reg.h.

#### 5.36.3.3 anonymous enum `anonymous enum`

**Enumerator**

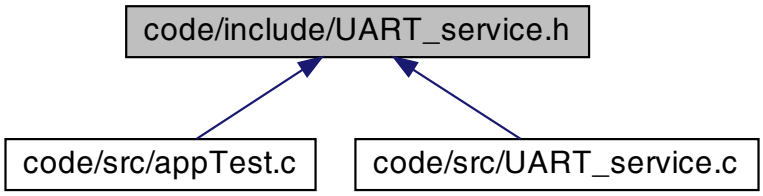
| | |
|---|---|
| UCPOL | |
| UCSZ0 | |
| UCSZ1 | |
| USBS | |
| UPM0 | |
| UPM1 | |
| UMSEL | |

Definition at line 56 of file UART_reg.h.

## 5.37 code/include/UART_service.h File Reference

UART services interfaces file.

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




### Functions

- void UART0_SendString (const u8 *const string)

  *Send a string using UART module 0.*
- void UART0_SendString_Checksum (const u8 *const string)
- void UART1_SendString (const u8 *const string)

  *Send a string using UART module 1.*
- void UART0_Send9BitString (const u16 *const string)

  *Send a sequence of elements, each element has 9 bits, using UART module 0.*
- void UART1_Send9BitString (const u16 *const string)

  *Send a sequence of elements, each element has 9 bits, using UART module 1.*
- void UART0_SendInteger (s32 integer)

  *Write Integer to UART0 as a string.*
- void UART1_SendInteger (s32 integer)

  *Write Integer to UART1 as a string.*
- void UART0_SendFloat (float number, const u8 precision)

  *Write Float to UART0 as a string.*
- void UART1_SendFloat (float number, const u8 precision)

  *Write Float to UART1 as a string.*
- ERROR_STATUS_t UART0_ReceiveString (u8 *const string)

  *Receive a string of characters (unsigned 8 bits data) using UART module 0.*
- void UART0_SendString_Asynchronous (const u8 *const string)
- ERROR_STATUS_t UART1_ReceiveString (u8 *const string)

  *Receive a string of characters (unsigned 8 bits data) using UART module 1.*
- void UART1_SendString_Asynchronous (const u8 *const string)
- ERROR_STATUS_t UART0_ReceiveString_Checksum (u8 *const string)
- ERROR_STATUS_t UART0_Receive9BitString (u16 *const string)

  *Receive a string of elements, each element has 9 bits, using UART module 0.*
- ERROR_STATUS_t UART1_Receive9BitString (u16 *const string)

  *Receive a string of elements, each element has 9 bits, using UART module 1.*

### 5.37.1 Detailed Description

UART services interfaces file.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-03

**Copyright**



### 5.37.2 Function Documentation

#### 5.37.2.1 UART0_Receive9BitString() ERROR_STATUS_t UART0_Receive9BitString ( u16 *const *string* )

Receive a string of elements, each element has 9 bits, using UART module 0.

**Parameters**

| | | |
|---|---|---|
| in | *string* | Pointer to the first element of the sequence (pointer to 16 bits) |

**Note**

Size of each element should be 2 Bytes to be able to receive 9 bits data

**For Example: UART0_Receive9BitDataSequence(string); will receive elements of 9 bits**

each from UART module 0.

**Warning**

The sequence will be ended with a NULL pointer(0): The last element of the sequence will be a NULL pointer. So, consider the length of the sequence as strlen(string) + 1.

Definition at line 394 of file UART_service.c.

#### 5.37.2.2 UART0_ReceiveString() ERROR_STATUS_t UART0_ReceiveString ( u8 *const string )

Receive a string of characters (unsigned 8 bits data) using UART module 0.

**For Example: UART0_ReceiveString(string); will receive a string of characters**

from UART module 0 and store it in variable <string>

**Returns**

The error code: ERROR_NO if no error, ERROR_YES if error

**Warning**

The string will be null terminated. So, the last character will be '\0'. So, the length of the string should be strlen(string) + 1.

Definition at line 386 of file UART_service.c.

Here is the caller graph for this function:


#### 5.37.2.3 UART0_ReceiveString_Checksum() ERROR_STATUS_t UART0_ReceiveString_Checksum ( u8 *const string )

Definition at line 403 of file UART_service.c.

Here is the caller graph for this function:


#### 5.37.2.4 UART0_Send9BitString() void UART0_Send9BitString ( const u16 *const string )

Send a sequence of elements, each element has 9 bits, using UART module 0.

**Parameters**

| | | |
|---|---|---|
| in | *string* | Pointer to the first element of the sequence |

**Note**

Size of each element should be 2 Bytes to be able to send 9 bits data

**For Example: UART0_Send9BitDataSequence(string); will send elements of 9 bits**

each to UART module 0.

**Note**

The sequence should be ended with a NULL pointer(0): The last element of the sequence should be a NULL pointer.

But if you are sending an array, you must explicitly null terminate it by adding '\0' at the end of the array --> string[lenght-1] = '\0'

Definition at line 331 of file UART_service.c.

#### 5.37.2.5 UART0_SendFloat()

```
void UART0_SendFloat (
        float number,
        const u8 precision )
```

Write Float to UART0 as a string.

**Parameters**

| | | |
|---|---|---|
| in | *number* | The number to be written |

**For Example:**

- UART0_WriteFloat(123.456, 3) will write the string "123.456" to UART0
- UART0_WriteFloat(123.456, 2) will write the string "123.45" to UART0
- UART0_WriteFloat(123.456, 5) will write the string "123.45600" to UART0
- UART0_WriteFloat(-123.456, 3) will write the string "-123.456" to UART0
- UART0_WriteFloat(-123.456, 2) will write the string "-123.45" to UART0
- UART0_WriteFloat(-123.456, 5) will write the string "-123.45600" to UART0

Definition at line 377 of file UART_service.c.

#### 5.37.2.6 UART0_SendInteger()

```
void UART0_SendInteger (
        s32 integer )
```

Write Integer to UART0 as a string.

**Parameters**

| | | |
|---|---|---|
| in | *integer* | The integer to be written |

**For Example:**

- UART0_WriteInt(123) will write the string "123" to UART0
- UART0_WriteInt(-123) will write the string "-123" to UART0

Definition at line 368 of file UART_service.c.

Here is the caller graph for this function:


#### 5.37.2.7 UART0_SendString() `void UART0_SendString ( const u8 *const string )`

Send a string using UART module 0.

**For Example: UART0_SendString("Hello World"); will send string "Hello World" to UART module 0**

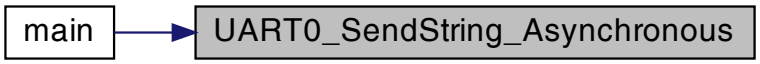
Definition at line 323 of file UART_service.c.

Here is the caller graph for this function:

#### 5.37.2.8 UART0_SendString_Asynchronous() void UART0_SendString_Asynchronous ( const u8 *const string )

Definition at line 340 of file UART_service.c.

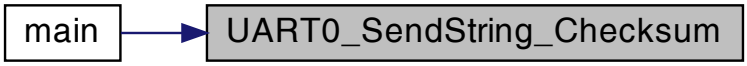
Here is the caller graph for this function:




#### 5.37.2.9 UART0_SendString_Checksum() void UART0_SendString_Checksum ( const u8 *const string )

Definition at line 359 of file UART_service.c.

Here is the caller graph for this function:




#### 5.37.2.10 UART1_Receive9BitString() ERROR_STATUS_t UART1_Receive9BitString ( u16 *const string )

Receive a string of elements, each element has 9 bits, using UART module 1.

**Parameters**

| | | |
|---|---|---|
| in | *string* | Pointer to the first element of the sequence (pointer to 16 bits) |

**Note**

Size of each element should be 2 Bytes to be able to receive 9 bits data

**For Example: UART1_Receive9BitDataSequence(string); will receive elements of 9 bits**

each from UART module 1.

**Warning**

The sequence will be ended with a NULL pointer(0): The last element of the sequence will be a NULL pointer. So, consider the length of the sequence as strlen(string) + 1.

Definition at line 398 of file UART_service.c.

#### 5.37.2.11 UART1_ReceiveString()

```
ERROR_STATUS_t UART1_ReceiveString (
        u8 *const string )
```

Receive a string of characters (unsigned 8 bits data) using UART module 1.

**For Example: UART1_ReceiveString(string); will receive a string of characters**

from UART module 1 and store it in variable <string>

**Returns**

The error code: ERROR_NO if no error, ERROR_YES if error

**Warning**

The string will be null terminated. So, the last character will be '\0'. So, the length of the string should be strlen(string) + 1.

Definition at line 390 of file UART_service.c.

#### 5.37.2.12 UART1_Send9BitString()

```
void UART1_Send9BitString (
        const u16 *const string )
```

Send a sequence of elements, each element has 9 bits, using UART module 1.

**Parameters**

| | | |
|---|---|---|
| in | *string* | Pointer to the first element of the sequence |

**Note**

Size of each element should be 2 Bytes to be able to send 9 bits data

**For Example: UART1_Send9BitDataSequence(string); will send elements of 9 bits**

each to UART module 1.

**Note**

The sequence should be ended with a NULL pointer(0): The last element of the sequence should be a NULL pointer.

But if you are sending an array, you must explicitly null terminate it by adding '\0' at the end of the array --> string[lenght-1] = '\0'

Definition at line 335 of file UART_service.c.

#### 5.37.2.13 UART1_SendFloat()

```
void UART1_SendFloat (
    float number,
    const u8 precision )
```

Write Float to UART1 as a string.

**Parameters**

| | | |
|---|---|---|
| in | *number* | The number to be written |

**For Example:**

- UART1_WriteFloat(123.456, 3) will write the string "123.456" to UART1
- UART1_WriteFloat(123.456, 2) will write the string "123.45" to UART1
- UART1_WriteFloat(123.456, 5) will write the string "123.45600" to UART1
- UART1_WriteFloat(-123.456, 3) will write the string "-123.456" to UART1
- UART1_WriteFloat(-123.456, 2) will write the string "-123.45" to UART1
- UART1_WriteFloat(-123.456, 5) will write the string "-123.45600" to UART1

Definition at line 381 of file UART_service.c.

Here is the caller graph for this function:


#### 5.37.2.14 UART1_SendInteger()

```
void UART1_SendInteger (
    s32 integer )
```

Write Integer to UART1 as a string.

**Parameters**

| | | |
|---|---|---|
| in | *integer* | The integer to be written |

**For Example:**

- UART1_WriteInt(123) will write the string "123" to UART1
- UART1_WriteInt(-123) will write the string "-123" to UART1

Definition at line 372 of file UART_service.c.

Here is the caller graph for this function:


#### 5.37.2.15 UART1_SendString() `void UART1_SendString ( const u8 *const string )`

Send a string using UART module 1.

**For Example: UART1_SendString("Hello World"); will send string "Hello World"**

to UART module 1.

**Note**

String must be null terminated: "Hello World\0". So, the last character must be '\0'.

Sending "Hello World" will send "Hello World\0" because it is null terminated implicitly. But if you are sending an array of characters, you must explicitly null terminate it by adding '\0' at the end of the array. --> string[lenght-1] = '\0'

Definition at line 327 of file UART_service.c.

Here is the caller graph for this function:

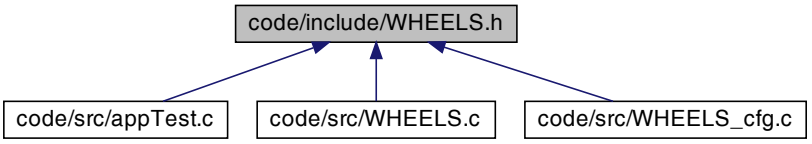
#### 5.37.2.16 UART1_SendString_Asynchronous() `void UART1_SendString_Asynchronous ( const u8 *const string )`

Definition at line 344 of file UART_service.c.

## 5.38 code/include/WHEELS.h File Reference

Interfaces header file for WHEELS.c.

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




### Enumerations

- enum WHEELS_POSITION_t { WHEELS_ON_FRONT , WHEELS_ON_BACK }
- enum WHEELS_TURN_t { SMOOTH_TURN , SHARP_TURN }

### Functions

- void WHEELS_Init (void)

  *Initialize the wheels module.*
- void WHEELS_GoForward (void)

  *Turn the wheels to go forward.*
- void WHEELS_GoBackward (void)

  *Turn the wheels to go backward.*
- void WHEELS_TurnLeft (WHEELS_TURN_t smoothOrSharp)

  *Turn the wheels to turn left.*
- void WHEELS_TurnRight (WHEELS_TURN_t smoothOrSharp)

  *Turn the wheels to turn right.*
- void WHEELS_Brake (void)

  *Brake the wheels.*
- void WHEELS_Coast (void)

  *Disables wheels and allows for free rolling.*
- void WHEELS_SetSpeed (u8 Speed)

  *Set the speed of the wheels.*
- void WHEELS_SetWheelsPosition (WHEELS_POSITION_t wheelsPositions)

  *Set the position of the wheels: on the front or on the back.*
- f32 WHEELS_GetCurrentConsumption ()

  *Get the current consumption of the wheels.*
- WHEELS_POSITION_t WHEELS_GetWheelsPosition (void)

  *Get the current position of the wheels.*

### 5.38.1 Detailed Description

Interfaces header file for WHEELS.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**



### 5.38.2 Enumeration Type Documentation

#### 5.38.2.1 WHEELS_POSITION_t enum WHEELS_POSITION_t

**Enumerator**

| | |
|---|---|
| WHEELS_ON_FRONT | |
| WHEELS_ON_BACK | |

Definition at line 12 of file WHEELS.h.

#### 5.38.2.2 WHEELS_TURN_t enum WHEELS_TURN_t

**Enumerator**

| | |
|---|---|
| SMOOTH_TURN | |
| SHARP_TURN | |

Definition at line 17 of file WHEELS.h.

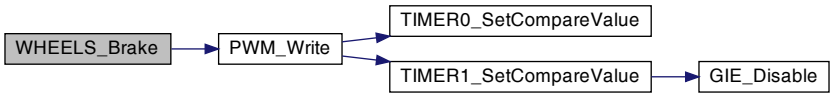
### 5.38.3 Function Documentation

#### 5.38.3.1 WHEELS_Brake() `void WHEELS_Brake ( void )`

Brake the wheels.

Definition at line 153 of file WHEELS.c.

Here is the call graph for this function:

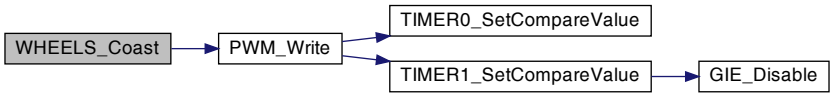



#### 5.38.3.2 WHEELS_Coast() `void WHEELS_Coast ( void )`

Disables wheels and allows for free rolling.

Definition at line 164 of file WHEELS.c.

Here is the call graph for this function:




#### 5.38.3.3 WHEELS_GetCurrentConsumption() `f32 WHEELS_GetCurrentConsumption ( )`

Get the current consumption of the wheels.

**Returns**

f32 The current consumption of the wheels in A.

#### 5.38.3.4 WHEELS_GetWheelsPosition() `WHEELS_POSITION_t WHEELS_GetWheelsPosition ( void )`

Get the current position of the wheels.

**Returns**

f32 The current consumption of the wheels in A.

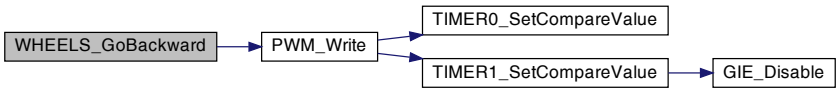
Definition at line 202 of file WHEELS.c.

#### 5.38.3.5 WHEELS_GoBackward() `void WHEELS_GoBackward ( void )`

Turn the wheels to go backward.

Definition at line 91 of file WHEELS.c.

Here is the call graph for this function:

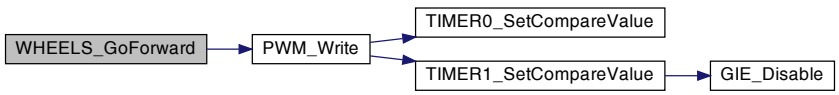



#### 5.38.3.6 WHEELS_GoForward() `void WHEELS_GoForward ( void )`

Turn the wheels to go forward.

Definition at line 79 of file WHEELS.c.

Here is the call graph for this function:

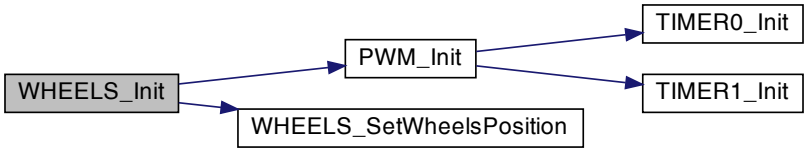


#### 5.38.3.7 WHEELS_Init() `void WHEELS_Init ( void )`

Initialize the wheels module.

Definition at line 68 of file WHEELS.c.

Here is the call graph for this function:




Here is the caller graph for this function:


#### 5.38.3.8 WHEELS_SetSpeed() `void WHEELS_SetSpeed ( u8 Speed )`

Set the speed of the wheels.

**Parameters**

| | | |
|---|---|---|
| in | *Speed* | The speed of the wheels. |

Definition at line 176 of file WHEELS.c.

#### 5.38.3.9 WHEELS_SetWheelsPosition() `void WHEELS_SetWheelsPosition ( WHEELS_POSITION_t wheelsPositions )`

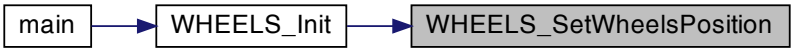
Set the position of the wheels: on the front or on the back.

**Parameters**

| | | |
|---|---|---|
| in | *wheelsPositions* | The poition of the wheels: WHEELS_ON_FRONT or WHEELS_ON_BACK. |

Definition at line 181 of file WHEELS.c.

Here is the caller graph for this function:



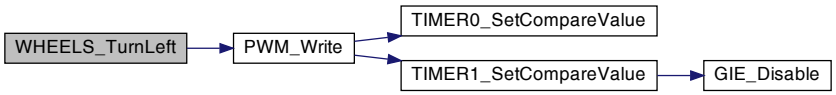

#### 5.38.3.10 WHEELS_TurnLeft() `void WHEELS_TurnLeft (`

`WHEELS_TURN_t` *smoothOrSharp* `)`

Turn the wheels to turn left.

Definition at line 103 of file WHEELS.c.

Here is the call graph for this function:



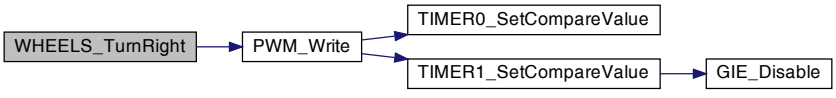

#### 5.38.3.11 WHEELS_TurnRight() `void WHEELS_TurnRight (`

`WHEELS_TURN_t` *smoothOrSharp* `)`

Turn the wheels to turn right.

Definition at line 128 of file WHEELS.c.

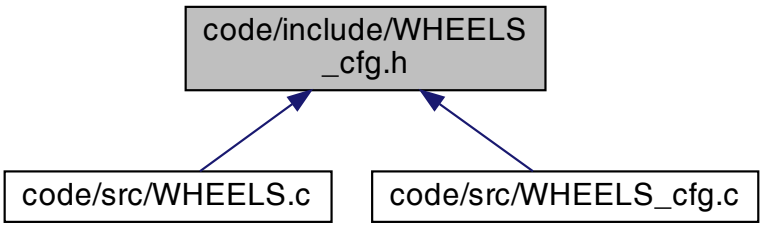
Here is the call graph for this function:



## 5.39 code/include/WHEELS_cfg.h File Reference

Configuration header file for WHEELS.c.

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




### Data Structures

- struct WHEELS_CONFIG_t

### Enumerations

- enum ROTATE_DIR_t {
  ROTATE_STOP , ROTATE_FWD , ROTATE_BACK , ROTATE_RIGHT_SMOOTH ,
  ROTATE_RIGHT_SHARP , ROTATE_LEFT_SMOOTH , ROTATE_LEFT_SHARP }

### Variables

- WHEELS_CONFIG_t WHEELS_Config

### 5.39.1 Detailed Description

Configuration header file for WHEELS.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

Copyright (c) 2022

### 5.39.2 Enumeration Type Documentation

#### 5.39.2.1 ROTATE_DIR_t enum ROTATE_DIR_t

**Enumerator**

| | |
|---|---|
| ROTATE_STOP | |
| ROTATE_FWD | |
| ROTATE_BACK | |
| ROTATE_RIGHT_SMOOTH | |
| ROTATE_RIGHT_SHARP | |
| ROTATE_LEFT_SMOOTH | |
| ROTATE_LEFT_SHARP | |

Definition at line 33 of file WHEELS_cfg.h.

### 5.39.3 Variable Documentation

#### 5.39.3.1 WHEELS_Config `WHEELS_CONFIG_t WHEELS_Config [extern]`

Definition at line 16 of file WHEELS_cfg.c.

## 5.40 code/src/appTest.c File Reference

```
#include <util/delay.h>
#include "STD_TYPES.h"
#include "BIT_MATH.h"
#include "GIE.h"
#include "DIO.h"
#include "EXTI.h"
#include "TIMER.h"
#include "SPI.h"
#include "UART.h"
#include "UART_service.h"
#include "BUTTON.h"
#include "LED.h"
#include "IR.h"
#include "LIFTER.h"
#include "WHEELS.h"
#include "BATTERY.h"
#include "NRF24.h"
```

Include dependency graph for appTest.c:


### Functions

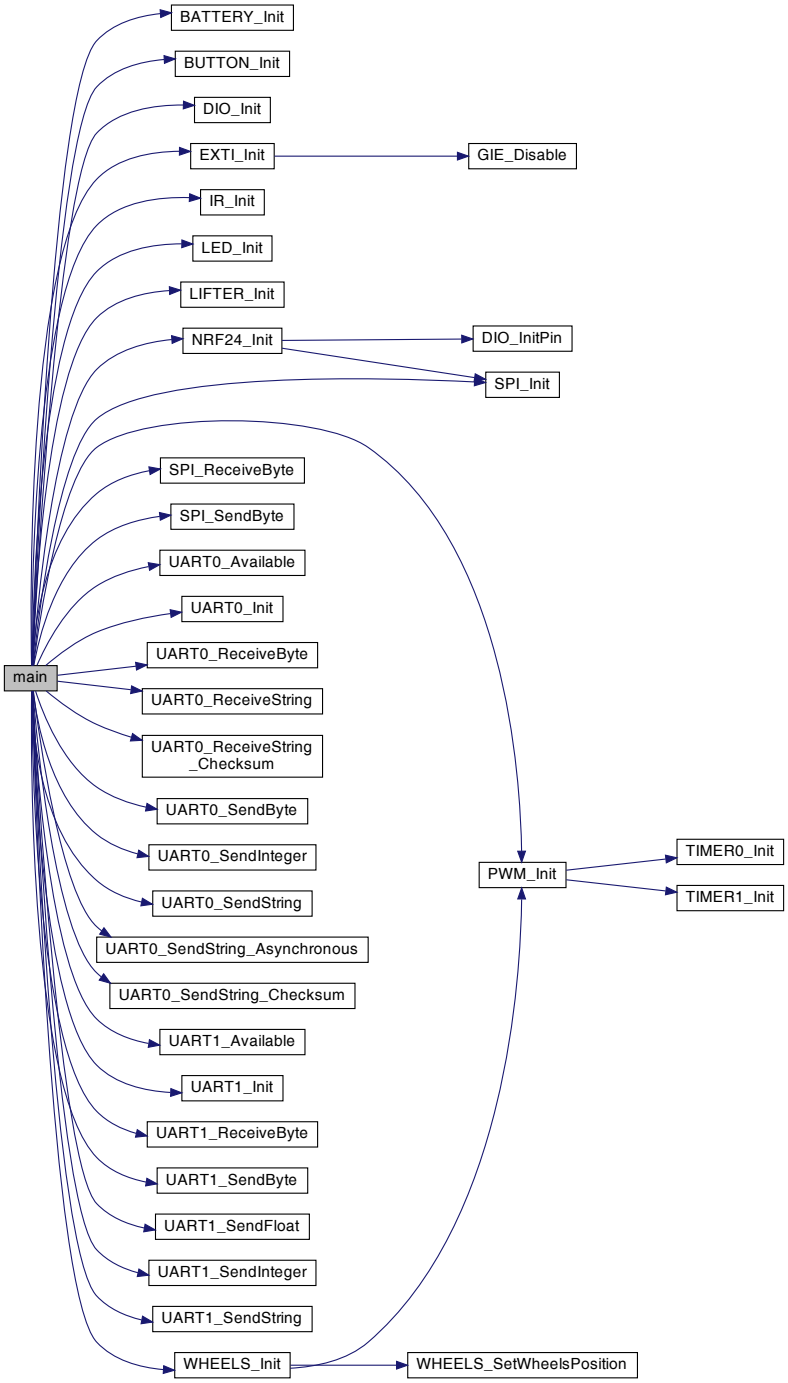
- int main (void)

### 5.40.1 Function Documentation

#### 5.40.1.1 main() `int main ( void )`

Definition at line 27 of file appTest.c.

Here is the call graph for this function:



## 5.41 code/src/BATTERY.c File Reference

Battery Management Module.

### 5.41.1 Detailed Description

Battery Management Module.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-02-08

**Copyright**

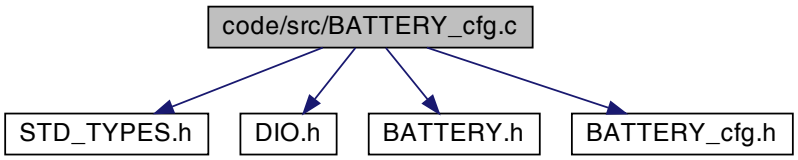
Copyright (c) 2022

## 5.42 code/src/BATTERY_cfg.c File Reference

Configuration source file for BATTERY.c.

```
#include "STD_TYPES.h"
#include "DIO.h"
#include "BATTERY.h"
#include "BATTERY_cfg.h"
```

Include dependency graph for BATTERY_cfg.c:




**Variables**

- BatteryConfigs_t BatteryConfigs

  *Configurations for the Battery Management Module.*

### 5.42.1 Detailed Description

Configuration source file for BATTERY.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

Copyright (c) 2022

### 5.42.2 Variable Documentation

#### 5.42.2.1 BatteryConfigs `BatteryConfigs_t BatteryConfigs`

**Initial value:**

```
= {
    .pin        = PIN_0,
    .port       = PORT_C,
    .minVoltage = 11.2f,
    .maxVoltage = 12.8f
}
```

Configurations for the Battery Management Module.

This is the configuration for the Battery Management Module. The configuration is done by the user. The user can change the configuration according to his needs.

**Note**

The configuration is done in the BATTERY_cfg.h and BATTERY_cfg.c files.

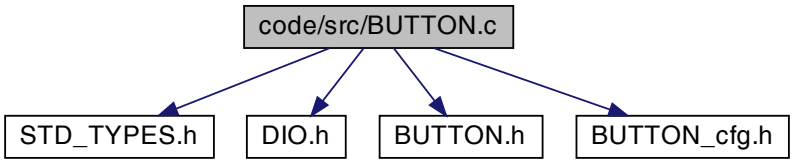
Definition at line 21 of file BATTERY_cfg.c.

## 5.43 code/src/BUTTON.c File Reference

Button Management Module.

```
#include "STD_TYPES.h"
#include "DIO.h"
#include "BUTTON.h"
#include "BUTTON_cfg.h"
```

Include dependency graph for BUTTON.c:




### Functions

- void BUTTON_Init (void)

  *Initializes Buttons connected to DIO.*
- STATE_t BUTTON_GetStatus (BUTTON_t button)

  *Check whether a specific button is pressed or not.*

### 5.43.1 Detailed Description

Button Management Module.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

Copyright (c) 2022

### 5.43.2 Function Documentation

#### 5.43.2.1 BUTTON_GetStatus() STATE_t BUTTON_GetStatus ( BUTTON_t *button* )

Check whether a specific button is pressed or not.

**Parameters**

| | | |
|---|---|---|
| in | *button* | Button number: options from BUTTON_t enum in BUTTON.h file |

**Returns**

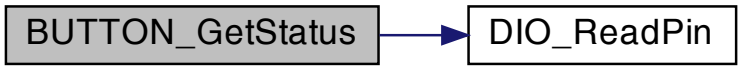
State of the button: HIGH if pressed and LOW if not, member of STATE_t enum

**For example:**

```
BUTTON_GetStatus(BUTTON_0);   //returns \ref HIGH if button 0 is pressed and \ref LOW otherwise
```

Definition at line 18 of file BUTTON.c.

Here is the call graph for this function:




#### 5.43.2.2 BUTTON_Init() `void BUTTON_Init ( void )`

Initializes Buttons connected to DIO.

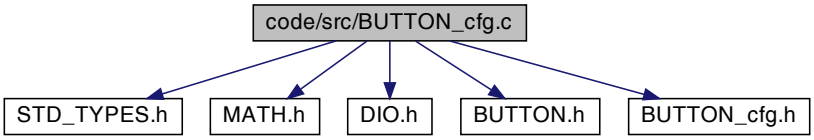
Definition at line 14 of file BUTTON.c.

Here is the caller graph for this function:

## 5.44 code/src/BUTTON_cfg.c File Reference

```
#include "STD_TYPES.h"
#include "MATH.h"
#include "DIO.h"
#include "BUTTON.h"
#include "BUTTON_cfg.h"
```

Include dependency graph for BUTTON_cfg.c:




### Variables

- BUTTON_CONFIGS_t buttonsConfigs [ ]
- const u8 countButtonsConfigured = SIZE_OF_ARRAY(buttonsConfigs)

### 5.44.1 Variable Documentation

#### 5.44.1.1 buttonsConfigs `BUTTON_CONFIGS_t buttonsConfigs[ ]`

**Initial value:**

```
= {
    {BUTTON_0, PIN_6, PORT_D, ACTIVE_LOW, DEBOUNCE_OFF},
    {BUTTON_1, PIN_7, PORT_D, ACTIVE_LOW, DEBOUNCE_OFF},
}
```

**Note**

ACTIVE_LOW means that the pin is:

- LOW when the sensor is pressed
- HIGH when the sensor is not pressed ACTIVE_HIGH means that the pin is:
- HIGH when the sensor is pressed
- LOW when the sensor is not pressed

Definition at line 23 of file BUTTON_cfg.c.

#### 5.44.1.2 countButtonsConfigured `const u8 countButtonsConfigured = SIZE_OF_ARRAY(buttonsConfigs)`

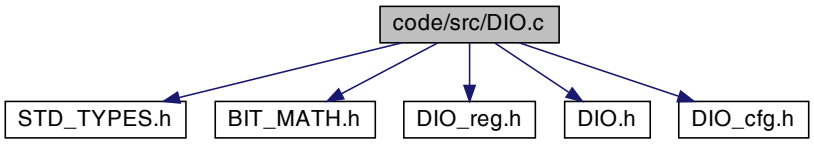
Definition at line 28 of file BUTTON_cfg.c.

## 5.45 code/src/DIO.c File Reference

Digital Input Output (DIO) driver for Atmega128 microcontroller.

```
#include "STD_TYPES.h"
#include "BIT_MATH.h"
#include "DIO_reg.h"
#include "DIO.h"
#include "DIO_cfg.h"
```

Include dependency graph for DIO.c:




### Macros

- #define INIT_PIN(pin, port, direction, pullup, direction_reg)

  *Used inside DIO_Init() to initialize a pin.*
- #define WRITE_PIN(pin, port, state)

  *used inside the writePin() function to write a pin Calling direction: DIO_WritePin() -> writePin() -> WRITE_PIN()*

### Functions

- void DIO_Init (void)

  *Initialize DIO configurations based on user configurations in DIO_cfg.h and DIO_cfg.c.*
- void DIO_InitPin (const PIN_t pin, const PORT_t port, const DIR_t direction, const PULLUP_t pullup)

  *Initialize a pin as input or output.*
- void DIO_WritePin (const PIN_t pin, const PORT_t port, const STATE_t pinState)

  *write a value on the output pins, options are defined in STD_TYPES.h in the enum STATE_t*
- void DIO_TogglePin (const PIN_t pin, const PORT_t port)
- void DIO_WritePort (const PORT_t port, const u8 value)

  *write a value on a specific port (value of 8-bits ranges from 0 to 255)*
- STATE_t DIO_ReadPin (const PIN_t pin, const PORT_t port)

  *Read the state of a pin.*
- u8 DIO_ReadPort (const PORT_t port)

  *Read the state of the port (8 bits --> 0-255)*

### 5.45.1 Detailed Description

Digital Input Output (DIO) driver for Atmega128 microcontroller.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**



### 5.45.2 Macro Definition Documentation

#### 5.45.2.1 INIT_PIN `#define INIT_PIN(`

*pin,*
*port,*
*direction,*
*pullup,*
*direction_reg )*

**Value:**

```
if(INPUT == direction) {                        \
    CLR_BIT(direction_reg, pin);                \
                                                \
    if(PULLUP_TRUE == pullup) {                 \
        SET_BIT(port, pin);                     \
    }                                           \
    else {                                       \
        CLR_BIT(port, pin);                     \
    }                                           \
}                                               \
else if(OUTPUT == direction) {                  \
    SET_BIT(direction_reg, pin);                \
    CLR_BIT(port, pin);                         \
}                                               \
else {     /* Invalid Direction    */           \
    ; /* Null operation       */                \
}
```

Used inside DIO_Init() to initialize a pin.

**Parameters**

| | |
|---|---|
| *pin* | pin to initialize, options are defined in DIO.h file in the enum PIN_t |
| *port* | port to initialize, options are defined in DIO.h file in the enum PORT_t |
| *direction* | pin direction, options are defined in DIO.h file in the enum DIRECTION_t |

Definition at line 25 of file DIO.c.

#### 5.45.2.2 WRITE_PIN #define WRITE_PIN( pin, port, state )

**Value:**

```
if(LOW == state) {                          \
    CLR_BIT(port, pin);                     \
}else if(HIGH == state) {                   \
    SET_BIT(port, pin);                     \
}else {     /* Invalid State    */          \
    ; /* Null operation       */            \
}
```

used inside the writePin() function to write a pin Calling direction: DIO_WritePin() -> writePin() -> WRITE_PIN()

**Parameters**

| | |
|---|---|
| *pin* | the pin number, options are defined in the DIO.h file in the enum PIN_t |
| *port* | the port number, options are defined in the DIO.h file in the enum PORT_t |
| *pinState* | the state of the pin, options are defined in the DIO.h file in the enum STATE_t |

Definition at line 51 of file DIO.c.

### 5.45.3 Function Documentation

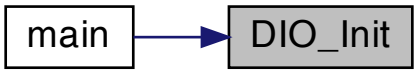
#### 5.45.3.1 DIO_Init() void DIO_Init ( void )

Initialize DIO configurations based on user configurations in DIO_cfg.h and DIO_cfg.c.

Initialize DIO pins to a specific direction (input or output), pullup or not according to the configuration in the DIO_cfg.h file.

Definition at line 67 of file DIO.c.

Here is the caller graph for this function:



#### 5.45.3.2 DIO_InitPin()

```
void DIO_InitPin (
        const PIN_t pin,
        const PORT_t port,
        const DIR_t direction,
        const PULLUP_t pullup )
```

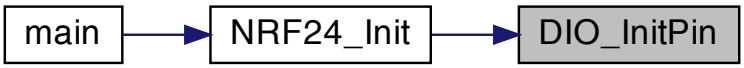
Initialize a pin as input or output.

If:

- DIO pin is not configured in the DIO_cfg.h file
- Or the pin is configurations need to be modified Then, this function will be called to modify the pin configuration.

Definition at line 110 of file DIO.c.

Here is the caller graph for this function:




#### 5.45.3.3 DIO_ReadPin()

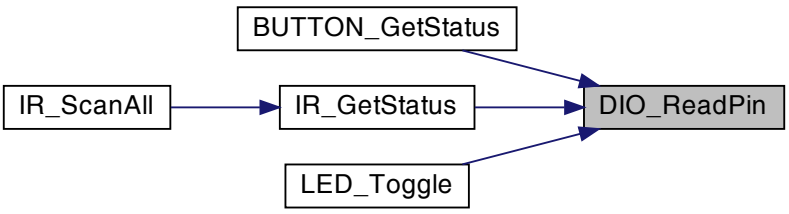
```
STATE_t DIO_ReadPin (
        const PIN_t pin,
        const PORT_t port )
```

Read the state of a pin.

If the pin is configured in the DIO_cfg.h file, then this function can be called to read the pin (1 or 0).

Definition at line 273 of file DIO.c.

Here is the caller graph for this function:



#### 5.45.3.4 DIO_ReadPort()

```
u8 DIO_ReadPort (
        const PORT_t port )
```

Read the state of the port (8 bits --> 0-255)

Read the value of the port (all pins).

Definition at line 321 of file DIO.c.

#### 5.45.3.5 DIO_TogglePin()

```
void DIO_TogglePin (
        const PIN_t pin,
        const PORT_t port )
```

This function can be called to toggle the state of the pin. If the pins state is HIGH, then it will be set to LOW, and vice versa.

Definition at line 192 of file DIO.c.

#### 5.45.3.6 DIO_WritePin()

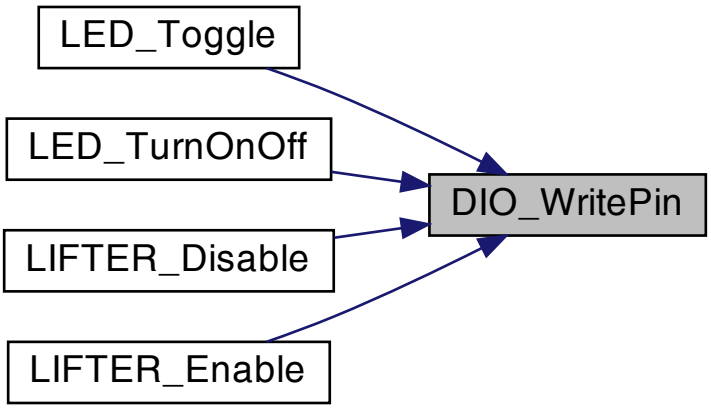
```
void DIO_WritePin (
        const PIN_t pin,
        const PORT_t port,
        const STATE_t pinState )
```

write a value on the output pins, options are defined in STD_TYPES.h in the enum STATE_t

If the pin is configured in the DIO_cfg.h file, then this function can be called to write to the pin (1 or 0).

Definition at line 149 of file DIO.c.

Here is the caller graph for this function:



#### 5.45.3.7 DIO_WritePort() `void DIO_WritePort (`

```
const PORT_t port,
const u8 value )
```

write a value on a specific port (value of 8-bits ranges from 0 to 255)

Write a value to the port (all pins).

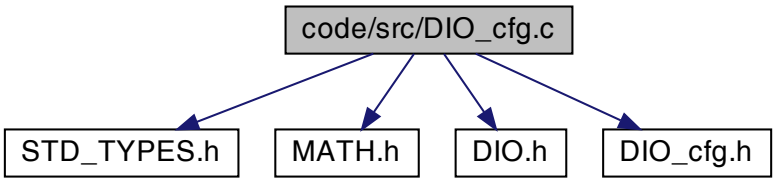
Definition at line 234 of file DIO.c.

## 5.46 code/src/DIO_cfg.c File Reference

Configuration source file for DIO.c.

```
#include "STD_TYPES.h"
#include "MATH.h"
#include "DIO.h"
#include "DIO_cfg.h"
```

Include dependency graph for DIO_cfg.c:




### Variables

- PinConfig_t pinConfigs [ ]
- const u8 countPinsConfigured = SIZE_OF_ARRAY(pinConfigs)

### 5.46.1 Detailed Description

Configuration source file for DIO.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

Copyright (c) 2022

### 5.46.2 Variable Documentation

#### 5.46.2.1 countPinsConfigured `const u8 countPinsConfigured = SIZE_OF_ARRAY(pinConfigs)`

Definition at line 53 of file DIO_cfg.c.

#### 5.46.2.2 pinConfigs `PinConfig_t pinConfigs[]`

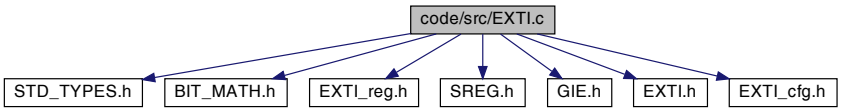
Definition at line 14 of file DIO_cfg.c.

## 5.47 code/src/EXTI.c File Reference

External Interrupts (EXTI) driver for Atmega128 microcontroller.

```
#include "STD_TYPES.h"
#include "BIT_MATH.h"
#include "EXTI_reg.h"
#include "SREG.h"
#include "GIE.h"
#include "EXTI.h"
#include "EXTI_cfg.h"
```

Include dependency graph for EXTI.c:




### Functions

- void __vector_1 (void)
- void __vector_2 (void)
- void __vector_3 (void)
- void __vector_4 (void)
- void __vector_5 (void)
- void __vector_6 (void)
- void __vector_7 (void)
- void __vector_8 (void)
- void EXTI_Init (const EXTI_t extiNumber, const EXTI_SENSITIVITY_t sensitivity, void(*const callback↩ Ptr)(void))

  *Initialize an EXTI pin with a given sensitivity and callback function.*
- void EXTI_EnableExternalInterrupt (const EXTI_t extiNumber)

  *Enable an EXTI pin (EXTI0 - EXTI7)*
- void EXTI_DisableExternalInterrupt (const EXTI_t extiNumber)

  *Disable an EXTI pin (EXTI0 - EXTI7)*

### 5.47.1 Detailed Description

External Interrupts (EXTI) driver for Atmega128 microcontroller.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-02-05

There are two types of interrupts:

1. Interrupts that are generated by the peripheral (HW interrupt).
2. Interrupts that are generated by the application (SW interrupt). The application can generate interrupts by calling the function EXTI_GenerateSWInterrupt(). The peripheral can generate interrupts by calling the function EXTI_GenerateHWInterrupt(). The application can clear the interrupt by calling the function EXTI_Clear↩ SWInterrupt().

There are 4 modes of interrupt generation:

1. Interrupt on falling edge.
2. Interrupt on rising edge.
3. Interrupt on both edges (On Change).
4. Interrupt on active level. When edge triggered, the interrupt is triggered only once when a falling edge from high logic level to low logic level happens. Only once even if the signal stays low, or goes high again. But when level triggered, the interrupt is triggered repeatedly while the logic level is low, continuously, until the logic level goes high again. So you really don't want to re-enable interrupts in a ISR which is triggered on low level. And if the level is low, not much mainline code gets chance to run, because the ISR is run repeatedly. So yes, basically low level and falling edge types of interrupts are both triggered when signal goes from high to low. Difference is that other gets triggered only once at the falling edge, the other triggers constantly while the level is low.

   **Note**

   INT0 to INT3 do not have (On Change mode)
   INT4 to INT7 need IO clock if configured as edge triggered.
   INT0 to INT3 use Asynchronous clock. So, they can wake up the MCU from sleep mode at any mode.

**Todo** Debug configuration of INT4 to INT7 as edge triggered not working.

**Copyright**

### 5.47.2 Function Documentation

#### 5.47.2.1 __vector_1() void __vector_1 ( void )

ISR of INT0

Definition at line 70 of file EXTI.c.

#### 5.47.2.2 __vector_2() void __vector_2 ( void )

ISR of INT1

Definition at line 91 of file EXTI.c.

#### 5.47.2.3 __vector_3() void __vector_3 ( void )

ISR of INT2

Definition at line 113 of file EXTI.c.

#### 5.47.2.4 __vector_4() void __vector_4 ( void )

ISR of INT3

Definition at line 134 of file EXTI.c.

#### 5.47.2.5 __vector_5() void __vector_5 ( void )

ISR of INT4

Definition at line 155 of file EXTI.c.

#### 5.47.2.6 __vector_6() void __vector_6 ( void )

ISR of INT5

Definition at line 176 of file EXTI.c.

#### 5.47.2.7 __vector_7() void __vector_7 ( void )

ISR of INT6

Definition at line 197 of file EXTI.c.

#### 5.47.2.8 __vector_8() void __vector_8 ( void )

ISR of INT7

Definition at line 218 of file EXTI.c.

#### 5.47.2.9 EXTI_DisableExternalInterrupt() void EXTI_DisableExternalInterrupt ( const EXTI_t *extiNumber* )

Disable an EXTI pin (EXTI0 - EXTI7)

**Parameters**

| | | |
|---|---|---|
| in | *extiNumber* | The EXTI pin to disable (EXTI0 - EXTI7) |

Definition at line 501 of file EXTI.c.

#### 5.47.2.10 EXTI_EnableExternalInterrupt() void EXTI_EnableExternalInterrupt ( const EXTI_t *extiNumber* )

Enable an EXTI pin (EXTI0 - EXTI7)

Enable external interrupt pin

Definition at line 453 of file EXTI.c.

Here is the call graph for this function:


#### 5.47.2.11 EXTI_Init()

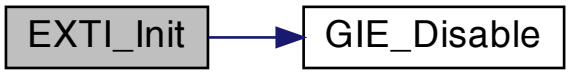
```
void EXTI_Init (
    const EXTI_t extiNumber,
    const EXTI_SENSITIVITY_t sensitivity,
    void(*)(void) callbackPtr )
```

Initialize an EXTI pin with a given sensitivity and callback function.

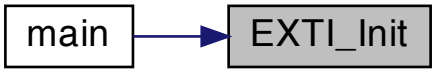
Initialize an external interrupt pin as input pin and set the

Definition at line 434 of file EXTI.c.

Here is the call graph for this function:




Here is the caller graph for this function:

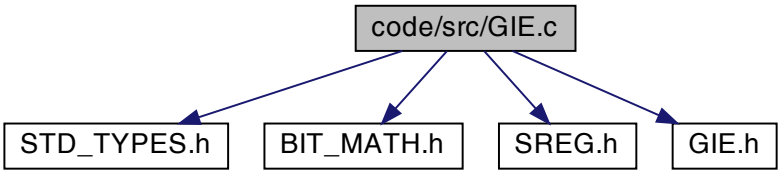


## 5.48 code/src/GIE.c File Reference

Global Interrupt Enable (GIE)

```
#include "STD_TYPES.h"
#include "BIT_MATH.h"
#include "SREG.h"
#include "GIE.h"
```

Include dependency graph for GIE.c:




### Functions

- void GIE_Disable (void)

  *Global Interrupt Disable (GID)*
- void GIE_Enable (void)

  *Global Interrupt Enable (GIE)*

### 5.48.1 Detailed Description

Global Interrupt Enable (GIE)

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-02-11

**Copyright**

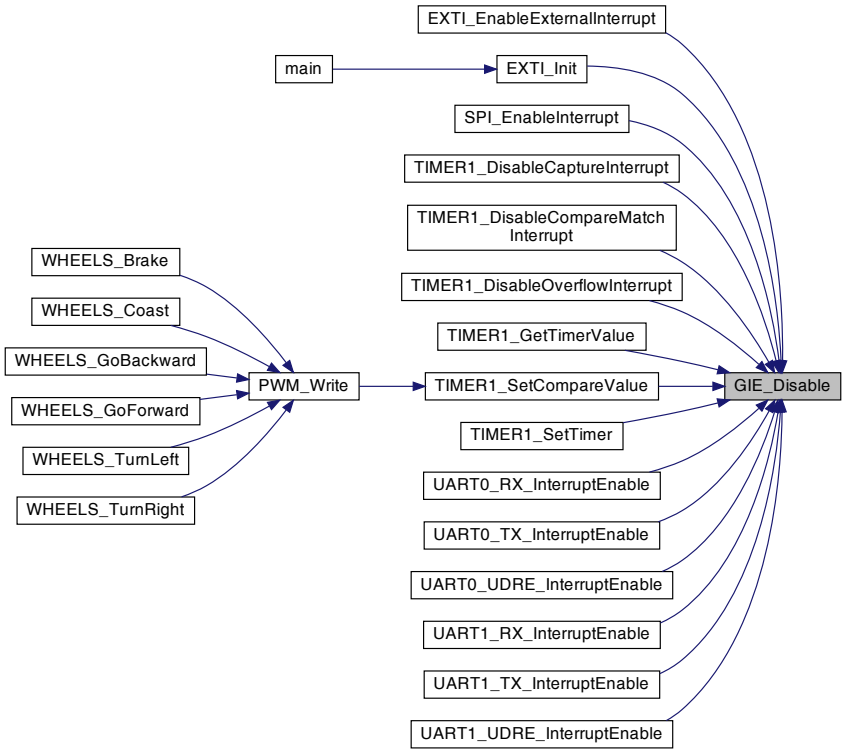
### 5.48.2 Function Documentation

#### 5.48.2.1 GIE_Disable() `void GIE_Disable ( void )`

Global Interrupt Disable (GID)

Definition at line 14 of file GIE.c.

Here is the caller graph for this function:

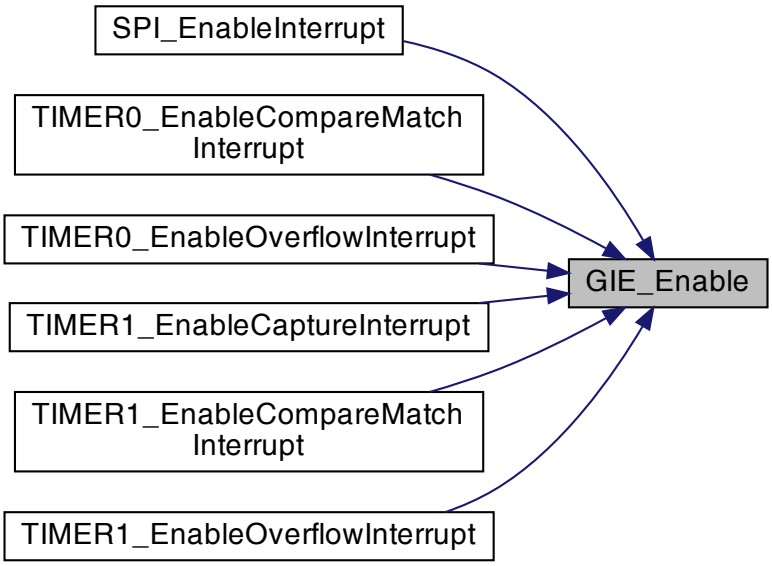



#### 5.48.2.2 GIE_Enable() `void GIE_Enable ( void )`

Global Interrupt Enable (GIE)

Definition at line 18 of file GIE.c.

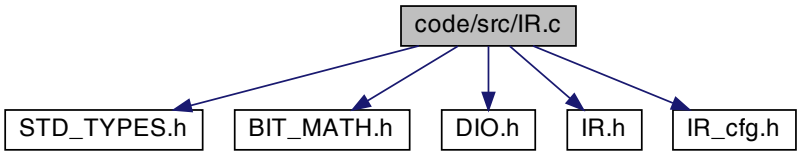
Here is the caller graph for this function:




## 5.49 code/src/IR.c File Reference

```
#include "STD_TYPES.h"
#include "BIT_MATH.h"
#include "DIO.h"
#include "IR.h"
#include "IR_cfg.h"
```

Include dependency graph for IR.c:




### Functions

- void IR_Init (void)

  *Initialize IR Sensors Configurations.*
- STATE_t IR_GetStatus (IR_SENSOR_t sensor)

  *Get status of a specific IR Sensor.*
- u32 IR_ScanAll (void)

  *Scan all IR Sensors and return the status of all of them.*
- u8 IR_GetCount (void)

  *Get the number of configured IR sensors.*

### 5.49.1 Function Documentation

#### 5.49.1.1 IR_GetCount() u8 IR_GetCount ( void )

Get the number of configured IR sensors.

**Returns**

Number of configured IR sensors

**Example:**

```
IR_GetNumOfSensors();  // returns 2 if only IR_0 and IR_1 are configured
```

Definition at line 51 of file IR.c.

#### 5.49.1.2 IR_GetStatus() STATE_t IR_GetStatus ( IR_SENSOR_t *sensor* )

Get status of a specific IR Sensor.

**Parameters**

| | | |
|---|---|---|
| in | *sensor* | Number of the sensor to be read; IR_0, IR_1, ..., IR7 |

**Returns**

State of the sensor; HIGH if White, LOW if black.

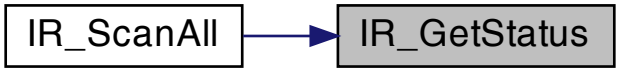
**Example:**

```
IR_GetStatus(IR_0);     // \ref HIGH if IR_0 is on white track and \ref LOW if black track, member of
 \ref STATE_t enum
```

Definition at line 18 of file IR.c.

Here is the call graph for this function:

Here is the caller graph for this function:



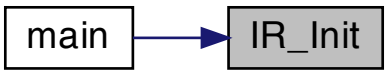

#### 5.49.1.3 IR_Init() `void IR_Init ( void )`

Initialize IR Sensors Configurations.

API FUNCTIONS

Definition at line 14 of file IR.c.

Here is the caller graph for this function:




#### 5.49.1.4 IR_ScanAll() `u32 IR_ScanAll ( void )`

Scan all IR Sensors and return the status of all of them.

**Returns**

State of all sensors; HIGH if White, LOW if black.

**Example:**

```
IR_ScanAll();
// when it returns a 0x0F00FFF0(0B0000_1111_0000_0000_1111_1111_1111_0000):
// This means:
//    * (IR_0 --> IR_15) and (IR_24 --> IR_27) are on white track.
//    * (IR_16 --> IR_23) and (IR_28 --> IR_31) are on black track.
```

**Note**

This function:

- Only scans the configured sensors. So, if you have configured only IR_0 and IR_1, this function will only return a maximum of 0x00000003 (0B0000_0000_0000_0000_0000_0000_0000_0011)
- Scans in the order of sensors' configurations. So, if you have configured IR_1 before IR_0 in the configuration, the status of IR_1 will be returned on bit 0 and the status of IR_0 will on bit 1.

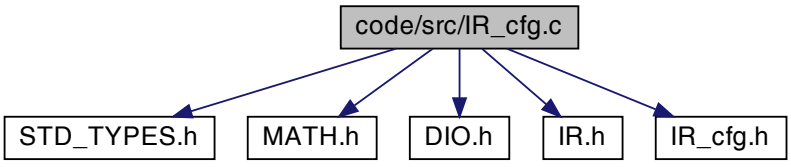
Definition at line 41 of file IR.c.

Here is the call graph for this function:


## 5.50 code/src/IR_cfg.c File Reference

```
#include "STD_TYPES.h"
#include "MATH.h"
#include "DIO.h"
#include "IR.h"
#include "IR_cfg.h"
```

Include dependency graph for IR_cfg.c:




### Variables

- IR_CONFIG_t IR_configs [ ]
- const u8 countIRSensorsConfigured = SIZE_OF_ARRAY(IR_configs)

#### 5.50.1 Variable Documentation

#### 5.50.1.1 countIRSensorsConfigured `const u8 countIRSensorsConfigured = SIZE_OF_ARRAY(IR_configs)`

Definition at line 28 of file IR_cfg.c.

#### 5.50.1.2 IR_configs `IR_CONFIG_t IR_configs[]`

**Initial value:**

```
= {
    {IR_0, PIN_2, PORT_E, ACTIVE_LOW},
    {IR_1, PIN_3, PORT_E, ACTIVE_LOW},
    {IR_2, PIN_4, PORT_E, ACTIVE_LOW}
}
```

**Note**

ACTIVE_LOW means that the pin is:

- LOW when the sensor is detecting an object (white)
- HIGH when the sensor is not detecting an object (black) ACTIVE_HIGH means that the pin is:
- HIGH when the sensor is detecting an object (white)
- LOW when the sensor is not detecting an object (black)

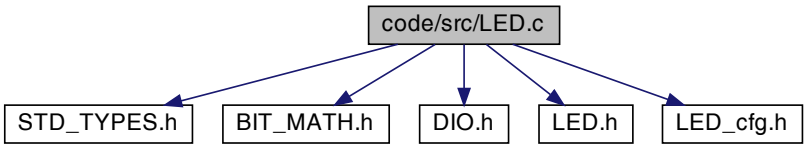
Definition at line 22 of file IR_cfg.c.

## 5.51 code/src/LED.c File Reference

LED Driver.

```
#include "STD_TYPES.h"
#include "BIT_MATH.h"
#include "DIO.h"
#include "LED.h"
#include "LED_cfg.h"
```

Include dependency graph for LED.c:




### Functions

- void LED_Init (void)

  *Initialize LEDs Configurations.*
- void LED_TurnOnOff (const LED_t led, const LED_STATE_t state)

  *Turn on/off a specific LED.*
- void LED_Toggle (const LED_t led)

  *Toggle state of a specific LED.*

### 5.51.1 Detailed Description

LED Driver.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-02-01

### 5.51.2 Function Documentation

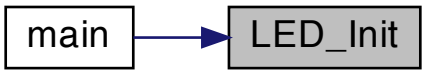
#### 5.51.2.1 LED_Init() `void LED_Init ( void )`

Initialize LEDs Configurations.

Initializes LEDs connected to DIO.

Definition at line 17 of file LED.c.

Here is the caller graph for this function:




#### 5.51.2.2 LED_Toggle() `void LED_Toggle ( const LED_t led )`

Toggle state of a specific LED.

**Parameters**

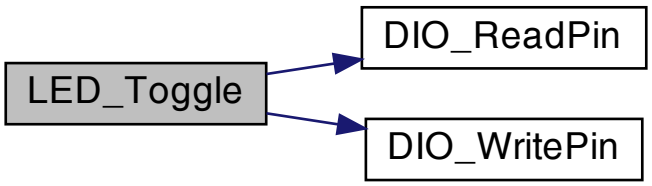
| | | |
|---|---|---|
| in | *led* | The LED to be oggles |

**Example:**

```
LED_Toggle(LED_0);   // toggle LED_0: LED_0 will be turned on if it was off and vice versa
```

Definition at line 45 of file LED.c.

Here is the call graph for this function:




#### 5.51.2.3 LED_TurnOnOff()

```
void LED_TurnOnOff (
        const LED_t led,
        const LED_STATE_t state )
```

Turn on/off a specific LED.

Turns on/off a specific LED.

**Parameters**

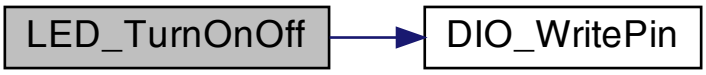
| | | |
|---|---|---|
| in | *led* | The LED to be turned on/off |
| in | *state* | The state of the LED, either LED_ON or LED_OFF |

**Example:**

```
LED_Set(LED_0, LED_ON);   // turn on LED_0
LED_Set(LED_0, LED_OFF);  // turn off LED_0
```

Definition at line 29 of file LED.c.

Here is the call graph for this function:

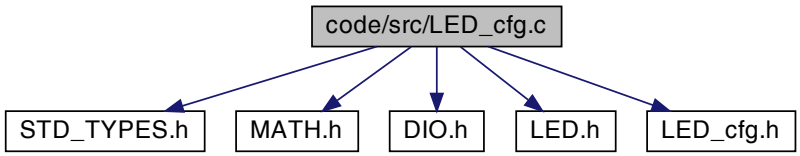



## 5.52 code/src/LED_cfg.c File Reference

Configuration source file for LED.c.

```
#include "STD_TYPES.h"
#include "MATH.h"
#include "DIO.h"
#include "LED.h"
#include "LED_cfg.h"
```

Include dependency graph for LED_cfg.c:




### Variables

- LED_CONFIGS_t ledConfigs [ ]
- const u8 countLedsConfigured = SIZE_OF_ARRAY(ledConfigs)

### 5.52.1 Detailed Description

Configuration source file for LED.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

Copyright (c) 2022

### 5.52.2 Variable Documentation

#### 5.52.2.1 countLedsConfigured `const u8 countLedsConfigured = SIZE_OF_ARRAY(ledConfigs)`

Definition at line 19 of file LED_cfg.c.

#### 5.52.2.2 ledConfigs `LED_CONFIGS_t ledConfigs[]`

**Initial value:**

```
= {
    {LED_0, PIN_6, PORT_F},
}
```

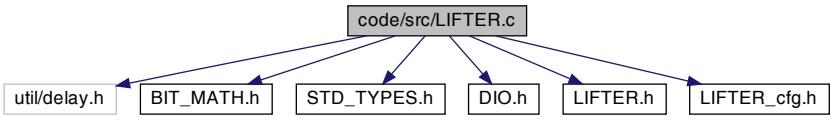
Definition at line 15 of file LED_cfg.c.

## 5.53 code/src/LIFTER.c File Reference

Lifter module that control the movement of the lifter actuator.

```
#include <util/delay.h>
#include "BIT_MATH.h"
#include "STD_TYPES.h"
#include "DIO.h"
#include "LIFTER.h"
#include "LIFTER_cfg.h"
```

Include dependency graph for LIFTER.c:




### Functions

- void LIFTER_Init (void)
  *Initialize the LIFTER module.*
- void LIFTER_MoveUp (void)
  *Move the lifter up until it reaches the top.*
- void LIFTER_MoveDown (void)
  *Move the lifter down until it reaches the bottom.*
- void LIFTER_Enable (void)
  *Enable the lifter motor.*
- void LIFTER_Disable (void)
  *Disable the lifter motor.*
- void LIFTER_SetSpeed (const u8 speed)
  *Set the speed of the lifter motor.*
- void LIFTER_SetOverallStroke (const u8 overallStroke)
  *Set the stroke of the lifter motor per revolution in mm.*
- void LIFTER_SetPulsesPerRevolution (const u16 pulsesPerRevolution)
  *Set the number of pulses per revolution.*
- void LIFTER_SetRevolutionStroke (const u8 revolutionStroke)
  *Set the distance per revolution.*

### 5.53.1 Detailed Description

Lifter module that control the movement of the lifter actuator.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

This module uses TB6560 motor driver to control the LIFTER. TB6560 is configured to use a stepper motor. And connected in common-anode mode: PUL-, DIR-, and EN- are connected to GND.

**Version**

1.0.0

**Date**

2022-02-09

**Copyright**



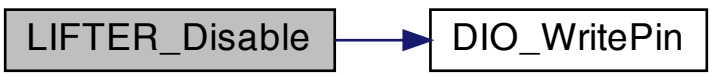
### 5.53.2 Function Documentation

#### 5.53.2.1 LIFTER_Disable() `void LIFTER_Disable ( void )`

Disable the lifter motor.

Definition at line 131 of file LIFTER.c.

Here is the call graph for this function:

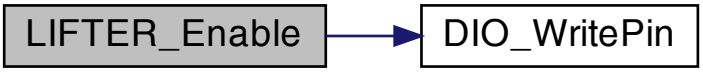


#### 5.53.2.2 LIFTER_Enable() `void LIFTER_Enable ( void )`

Enable the lifter motor.

Definition at line 124 of file LIFTER.c.

Here is the call graph for this function:




#### 5.53.2.3 LIFTER_Init() `void LIFTER_Init ( void )`

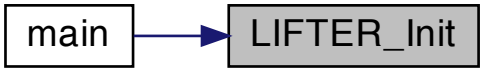
Initialize the LIFTER module.

Initialize the lifter.

API FUNCTIONS IMPLEMENTATION ∗

Definition at line 103 of file LIFTER.c.

Here is the caller graph for this function:




#### 5.53.2.4 LIFTER_MoveDown() `void LIFTER_MoveDown ( void )`

Move the lifter down until it reaches the bottom.

Move the lifter down.

Definition at line 117 of file LIFTER.c.

#### 5.53.2.5 LIFTER_MoveUp() `void LIFTER_MoveUp ( void )`

Move the lifter up until it reaches the top.

Move the lifter up.

Definition at line 110 of file LIFTER.c.

#### 5.53.2.6 LIFTER_SetOverallStroke() `void LIFTER_SetOverallStroke ( const u8 overallStroke )`

Set the stroke of the lifter motor per revolution in mm.

**Parameters**

| | | |
|---|---|---|
| in | *overallStroke* | The stroke of the lifter motor per revolution in mm |

Definition at line 147 of file LIFTER.c.

#### 5.53.2.7 LIFTER_SetPulsesPerRevolution() `void LIFTER_SetPulsesPerRevolution ( const u16 pulsesPerRevolution )`

Set the number of pulses per revolution.

**Parameters**

| | | |
|---|---|---|
| in | *pulsesPerRevolution* | The number of pulses per revolution |

Definition at line 155 of file LIFTER.c.

#### 5.53.2.8 LIFTER_SetRevolutionStroke() `void LIFTER_SetRevolutionStroke ( const u8 revolutionStroke )`

Set the distance per revolution.

**Parameters**

| | | |
|---|---|---|
| in | *revolutionStroke* | The distance per revolution in mm |

Definition at line 163 of file LIFTER.c.

#### 5.53.2.9 LIFTER_SetSpeed() `void LIFTER_SetSpeed ( const u8 speed )`

Set the speed of the lifter motor.

**Parameters**

| | | |
|---|---|---|
| in | *speed* | The speed of the lifter motor |

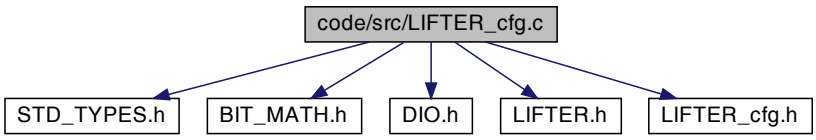
Definition at line 139 of file LIFTER.c.

## 5.54 code/src/LIFTER_cfg.c File Reference

Configuration source file for LIFTER.c.

```
#include "STD_TYPES.h"
#include "BIT_MATH.h"
#include "DIO.h"
#include "LIFTER.h"
#include "LIFTER_cfg.h"
```

Include dependency graph for LIFTER_cfg.c:




### Variables

- LIFTER_CONFIGS_t LifterConfigs
  *Lifter configurations.*

### 5.54.1 Detailed Description

Configuration source file for LIFTER.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

### 5.54.2 Variable Documentation

#### 5.54.2.1 LifterConfigs `LIFTER_CONFIGS_t LifterConfigs`

**Initial value:**

```
= {
    .directionPin       = PIN_4,
    .directionPinPort   = PORT_D,
    .pulsePin           = PIN_5,
    .pulsePinPort       = PORT_D,
    .enablePin          = PIN_6,
    .enablePinPort      = PORT_D,
    .overallStroke      = (u8)20,
    .pulsesPerRevolution = (u16)1600,
    .revolutionStroke   = (u8)2,
    .speed              = (u8)4,
}
```

Lifter configurations.

**Note**

stepSize is the number of millimeters that the lifter will move when calling LIFTER_move function.
For example, if the stepSize is 10, the lifter will move 10 millimeters when calling LIFTER_move function.

pulsePerRevolution is the number of pulses that the lifter will make to make one revolution.
For example, if the pulsePerRevolution is 200, the lifter will make 200 pulses to make one revolution. Options:

- 200 --> Full step
- 400 --> Half step
- 800 --> 1/4 step --> Not allowed with TB6560
- 1600 --> 1/8 step
- 3200 --> 1/16 step
- 6400 --> 1/32 step --> Not allowed with TB6560

distancePerRevolution is the number of millimeters that the lifter will move in one revolution.
For example, if the distancePerRevolution is 100, the lifter will move 100 millimeters in one revolution.

speed is the number of millimeters that the lifter will move in one second. For example, if the speed is 100, the lifter will move 100 millimeters in one second.

speed must be less <= stepSize

You can change default speed, overallStroke, pulsePerRevolution, and revolutionStroke by calling faunctions LIFTER_SetSpeed, LIFTER_SetOverallStroke, LIFTER_SetPulsesPerRevolution, and LIFTER_SetRevolution↩ Stroke. See prototypes of these functions for more details.

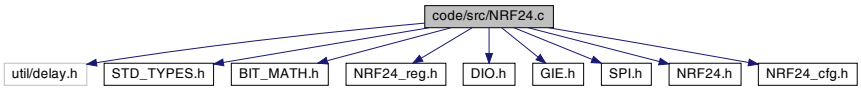
Definition at line 46 of file LIFTER_cfg.c.

## 5.55 code/src/NRF24.c File Reference

NRF24 wireless transceiver module driver.

```
#include "util/delay.h"
#include "STD_TYPES.h"
#include "BIT_MATH.h"
#include "NRF24_reg.h"
#include "DIO.h"
#include "GIE.h"
#include "SPI.h"
#include "NRF24.h"
#include "NRF24_cfg.h"
```

Include dependency graph for NRF24.c:




### Functions

- void NRF24_Init (void)
- void NRF24_TxMode (void)
- void NRF24_SendString (u8 *data, u8 len)
- void NRF24_RxMode (void)
- u8 NRF24_Available (void)
- ERROR_STATUS_t NRF24_ReceiveString (u8 *data, u8 length)

### 5.55.1 Detailed Description

NRF24 wireless transceiver module driver.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

### 5.55.2 Function Documentation

#### 5.55.2.1 NRF24_Available()

```
u8 NRF24_Available (
        void  )
```

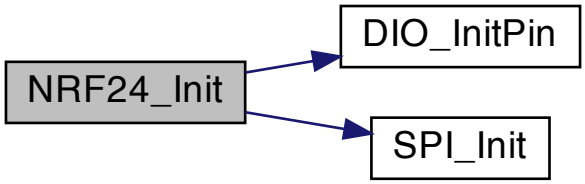
Definition at line 307 of file NRF24.c.

#### 5.55.2.2 NRF24_Init()

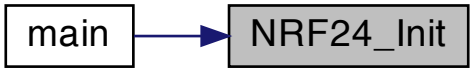
```
void NRF24_Init (
        void  )
```

Definition at line 155 of file NRF24.c.

Here is the call graph for this function:




Here is the caller graph for this function:




#### 5.55.2.3 NRF24_ReceiveString()

```
ERROR_STATUS_t NRF24_ReceiveString (
        u8 * data,
        u8 length )
```

Definition at line 328 of file NRF24.c.

#### 5.55.2.4 NRF24_RxMode() `void NRF24_RxMode (`

```
void  )
```

Definition at line 249 of file NRF24.c.

#### 5.55.2.5 NRF24_SendString() `void NRF24_SendString (`

```
u8 * data,
u8 len )
```

Definition at line 214 of file NRF24.c.

#### 5.55.2.6 NRF24_TxMode() `void NRF24_TxMode (`

```
void  )
```

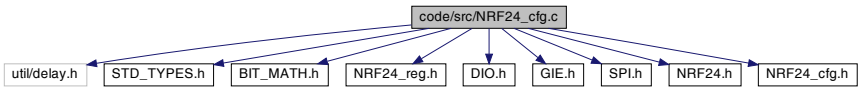
Definition at line 191 of file NRF24.c.

## 5.56 code/src/NRF24_cfg.c File Reference

Configuration source file for NRF24.c.

```
#include "util/delay.h"
#include "STD_TYPES.h"
#include "BIT_MATH.h"
#include "NRF24_reg.h"
#include "DIO.h"
#include "GIE.h"
#include "SPI.h"
#include "NRF24.h"
#include "NRF24_cfg.h"
```

Include dependency graph for NRF24_cfg.c:




### Variables

- NRF24_t NRF24_cfg

### 5.56.1 Detailed Description

Configuration source file for NRF24.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

Copyright (c) 2022

### 5.56.2 Variable Documentation

#### 5.56.2.1 NRF24_cfg NRF24_t NRF24_cfg

**Initial value:**

```
= {
    .pins  = {  .ce  = { .pin = PIN_7, .port = PORT_E },
                .csn = { .pin = PIN_0, .port = PORT_B }
             },
    .channel    = 76,
    .payload_len = 20,
    .addressWidth = 5,
    .txAddress  = { 0xE7, 0xE7, 0xE7, 0xE7, 0xE7 },
    .rx0Address = { 0xE7, 0xD3, 0xF0, 0x35, 0x77, },
    .rx1Address = { 0xC2, 0xC2, 0xC2, 0xC2, 0xC2 },
    .rx2Address = { 0xC3, 0xC2, 0xC2, 0xC2, 0xC2 },
    .rx3Address = { 0xC4, 0xC2, 0xC2, 0xC2, 0xC2 },
    .rx4Address = { 0xC5, 0xC2, 0xC2, 0xC2, 0xC2 },
    .rx5Address = { 0xC6, 0xC2, 0xC2, 0xC2, 0xC2 },
    .rxPipe = RX_PIPE1,
}
```

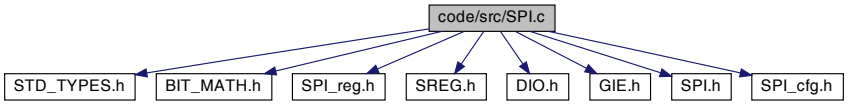
Definition at line 19 of file NRF24_cfg.c.

## 5.57 code/src/SPI.c File Reference

SPI driver for ATMEGA128 microcontroller.

```
#include "STD_TYPES.h"
#include "BIT_MATH.h"
#include "SPI_reg.h"
#include "SREG.h"
#include "DIO.h"
#include "GIE.h"
#include "SPI.h"
#include "SPI_cfg.h"
```

Include dependency graph for SPI.c:



### Functions

- void SPI_SetCallBack (void(*ptrCallback)(void))
- void __vector_17 (void)
- void SPI_Init (void)
- void SPI_EnableInterrupt (void(*ptrCallback)(void))
- void SPI_DisableInterrupt (void)
- ERROR_STATUS_t SPI_SendByte (const u8 data)
- ERROR_STATUS_t SPI_SendString (const u8 *str, u8 length)
- ERROR_STATUS_t SPI_ReceiveByte (u8 *const data)
- void SPI_TrancieveByte (const u8 dataToSend, u8 *const dataReceived)
- ERROR_STATUS_t SPI_ReceiveString (u8 *const str, u8 length)

### Variables

- void(* SPI_StcCallBack )(void)

#### 5.57.1 Detailed Description

SPI driver for ATMEGA128 microcontroller.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-03 @features: - SPI Master mode

- SPI Slave mode
- SPI Interrupt mode
- SPI DMA mode
- SPI Double Speed mode

**Copyright**



#### 5.57.2 Function Documentation

#### 5.57.2.1 __vector_17() `void __vector_17 ( void )`

Definition at line 37 of file SPI.c.

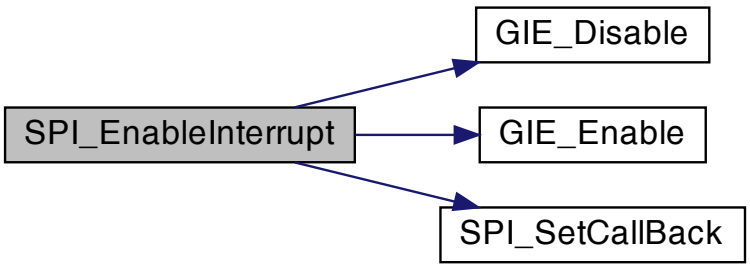
#### 5.57.2.2 SPI_DisableInterrupt() `void SPI_DisableInterrupt ( void )`

Definition at line 238 of file SPI.c.

#### 5.57.2.3 SPI_EnableInterrupt() `void SPI_EnableInterrupt ( void(*)(void) ptrCallback )`

Definition at line 229 of file SPI.c.

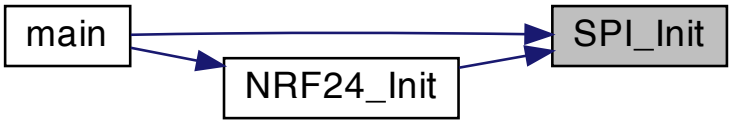
Here is the call graph for this function:




#### 5.57.2.4 SPI_Init() `void SPI_Init ( void )`

Definition at line 212 of file SPI.c.

Here is the caller graph for this function:

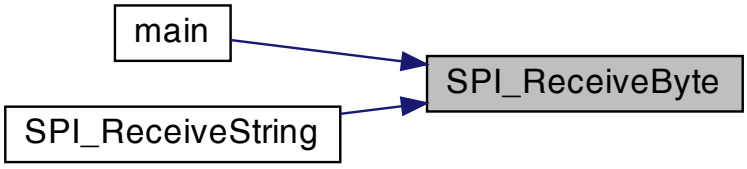


#### 5.57.2.5 SPI_ReceiveByte()

```
ERROR_STATUS_t SPI_ReceiveByte (
        u8 *const data )
```

Definition at line 273 of file SPI.c.

Here is the caller graph for this function:




#### 5.57.2.6 SPI_ReceiveString()

```
ERROR_STATUS_t SPI_ReceiveString (
        u8 *const str,
        u8 length )
```

Definition at line 293 of file SPI.c.

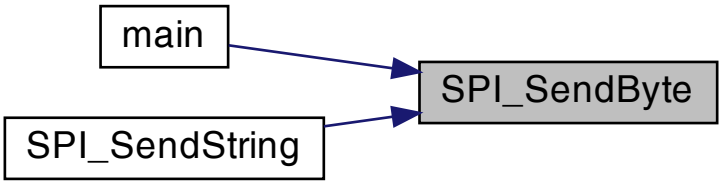
Here is the call graph for this function:


#### 5.57.2.7 SPI_SendByte()

```
ERROR_STATUS_t SPI_SendByte (
        const u8 data )
```

Definition at line 242 of file SPI.c.

Here is the caller graph for this function:




#### 5.57.2.8 SPI_SendString() ERROR_STATUS_t SPI_SendString ( const u8 * str, u8 length )

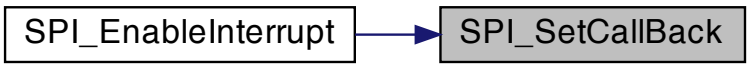
Definition at line 258 of file SPI.c.

Here is the call graph for this function:


#### 5.57.2.9 SPI_SetCallBack() void SPI_SetCallBack ( void(*)(void) ptrCallback )

Definition at line 29 of file SPI.c.

Here is the caller graph for this function:



#### 5.57.2.10 SPI_TrancieveByte() `void SPI_TrancieveByte (`

```
const u8 dataToSend,
u8 *const dataReceived )
```

Definition at line 285 of file SPI.c.

### 5.57.3 Variable Documentation

#### 5.57.3.1 SPI_StcCallBack `void(* SPI_StcCallBack) (void) (`

```
void  )
```

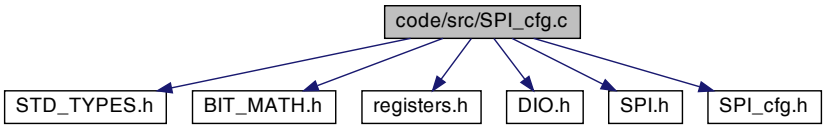
Definition at line 27 of file SPI.c.

## 5.58 code/src/SPI_cfg.c File Reference

Configuration source file for SPI.c.

```
#include "STD_TYPES.h"
#include "BIT_MATH.h"
#include "registers.h"
#include "DIO.h"
#include "SPI.h"
#include "SPI_cfg.h"
```

Include dependency graph for SPI_cfg.c:




### Variables

- SPI_CONFIG_t SPI_Config

### 5.58.1 Detailed Description

Configuration source file for SPI.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-20

**Copyright**

Copyright (c) 2022

### 5.58.2 Variable Documentation

#### 5.58.2.1 SPI_Config SPI_CONFIG_t SPI_Config

**Initial value:**

```
= {
    .connections = {
        .SS     = { .pin = PIN_0, .port = PORT_B},
        .SCK    = { .pin = PIN_1, .port = PORT_B},
        .MOSI   = { .pin = PIN_2, .port = PORT_B},
        .MISO   = { .pin = PIN_3, .port = PORT_B}
    },
    .mode           = SPI_MASTER,
    .clockDivider   = SPI_PRESCALER_8,
    .dataOrder      = SPI_DATA_ORDER_MSB_FIRST,
    .doubleSpeed    = SPI_DOUBLE_SPEED_DISABLE,
    .clockMode      = SPI_MODE0,
}
```

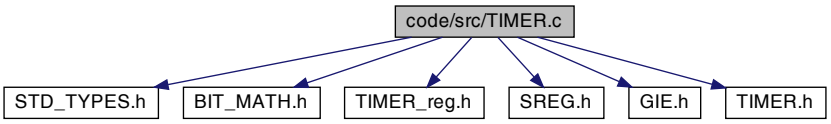
Definition at line 17 of file SPI_cfg.c.

## 5.59 code/src/TIMER.c File Reference

Timer driver for ATMEGA128 microcontroller.

```
#include "STD_TYPES.h"
#include "BIT_MATH.h"
#include "TIMER_reg.h"
#include "SREG.h"
#include "GIE.h"
#include "TIMER.h"
```

Include dependency graph for TIMER.c:




### Functions

- void TIMER0_SetCallBack (void(*ptr)(void))
- void TIMER0_SetCompareCallBack (void(*ptr)(void))
- void TIMER1_SetCallBack (void(*ptr)(void))
- void TIMER1_SetCompareCallBackA (void(*ptr)(void))
- void TIMER1_SetCompareCallBackB (void(*ptr)(void))
- void TIMER1_SetCompareCallBackC (void(*ptr)(void))
- void TIMER1_SetCaptureCallBack (void(*ptr)(void))
- void TIMER2_SetCallBack (void(*ptr)(void))
- void TIMER2_SetCompareCallBack (void(*ptr)(void))
- void TIMER3_SetCallBack (void(*ptr)(void))
- void TIMER3_SetCompareCallBackA (void(*ptr)(void))

- void TIMER3_SetCompareCallBackB (void(∗ptr)(void))
- void TIMER3_SetCompareCallBackC (void(∗ptr)(void))
- void TIMER3_SetCaptureCallBack (void(∗ptr)(void))
- void TIMER0_Init (u8 initValue, TIMER_CLOCK_t clock, TIMER_MODE_t timerMode, TIMER_OC_t compareMode)
- void TIMER0_SetCompareValue (u8 u8CompareValue)
- void TIMER0_SetTimer (u8 u8TimerValue)
- void TIMER0_EnableOverflowInterrupt (void(∗callBackPtr)(void))
- void TIMER0_DisableOverflowInterrupt (void)
- void TIMER0_EnableCompareMatchInterrupt (void(∗callBackPtr)(void))
- void TIMER0_DisableCompareMatchInterrupt (void)
- u8 TIMER0_GetTimerValue (void)
- void PWM0_Write (u8 dutyPercentage)
- void TIMER1_Init (u16 initValue, TIMER_CLOCK_t clock, TIMER_MODE_t timerMode, TIMER_OC_t compareMode, TIMER_OCx_t OCx)
- void TIMER1_SetCompareValue (u16 u16CompareValue, TIMER_OCx_t OCx)
- void TIMER1_SetTimer (u16 u16TimerValue)
- void TIMER1_EnableOverflowInterrupt (void(∗callBackPtr)(void))
- void TIMER1_DisableOverflowInterrupt (void)
- void TIMER1_EnableCompareMatchInterrupt (TIMER_OCx_t OCx, void(∗callBackPtr)(void))
- void TIMER1_DisableCompareMatchInterrupt (TIMER_OCx_t OCx)
- void TIMER1_EnableCaptureInterrupt (void(∗callBackPtr)(void))
- void TIMER1_DisableCaptureInterrupt (void)
- u16 TIMER1_GetTimerValue (void)
- void PWM_Init (PWM_t channel, u32 frequency)
- void PWM_Write (PWM_t channel, u8 dutyPercentage)
- void __vector_16 (void)
- void __vector_15 (void)
- void __vector_14 (void)
- void __vector_13 (void)
- void __vector_12 (void)
- void __vector_24 (void)
- void __vector_11 (void)
- void __vector_10 (void)
- void __vector_9 (void)
- void __vector_29 (void)
- void __vector_28 (void)
- void __vector_27 (void)
- void __vector_26 (void)
- void __vector_25 (void)

### 5.59.1 Detailed Description

Timer driver for ATMEGA128 microcontroller.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-02-11

**Copyright**

Copyright (c) 2022

### 5.59.2 Function Documentation

#### 5.59.2.1 __vector_10() `void __vector_10 ( void )`

Definition at line 914 of file TIMER.c.

#### 5.59.2.2 __vector_11() `void __vector_11 ( void )`

Definition at line 901 of file TIMER.c.

#### 5.59.2.3 __vector_12() `void __vector_12 ( void )`

Definition at line 875 of file TIMER.c.

#### 5.59.2.4 __vector_13() `void __vector_13 ( void )`

Definition at line 862 of file TIMER.c.

#### 5.59.2.5 __vector_14() `void __vector_14 ( void )`

Definition at line 849 of file TIMER.c.

#### 5.59.2.6 __vector_15() `void __vector_15 ( void )`

Definition at line 836 of file TIMER.c.

#### 5.59.2.7 __vector_16() `void __vector_16 ( void )`

Definition at line 823 of file TIMER.c.

#### 5.59.2.8 __vector_24() void __vector_24 ( void )

Definition at line 888 of file TIMER.c.

#### 5.59.2.9 __vector_25() void __vector_25 ( void )

Definition at line 992 of file TIMER.c.

#### 5.59.2.10 __vector_26() void __vector_26 ( void )

Definition at line 979 of file TIMER.c.

#### 5.59.2.11 __vector_27() void __vector_27 ( void )

Definition at line 966 of file TIMER.c.

#### 5.59.2.12 __vector_28() void __vector_28 ( void )

Definition at line 953 of file TIMER.c.

#### 5.59.2.13 __vector_29() void __vector_29 ( void )

Definition at line 940 of file TIMER.c.

#### 5.59.2.14 __vector_9() void __vector_9 ( void )

Definition at line 927 of file TIMER.c.

#### 5.59.2.15 PWM0_Write()

```
void PWM0_Write (
        u8 dutyPercentage )
```

Definition at line 574 of file TIMER.c.

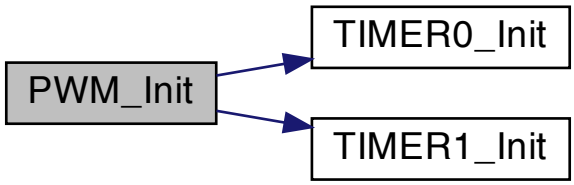
Here is the call graph for this function:


#### 5.59.2.16 PWM_Init()

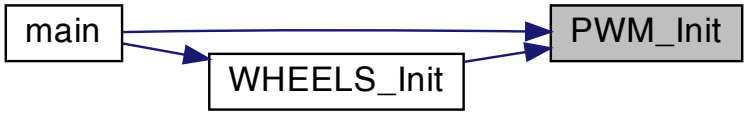
```
void PWM_Init (
        PWM_t channel,
        u32 frequency )
```

Definition at line 755 of file TIMER.c.

Here is the call graph for this function:




Here is the caller graph for this function:

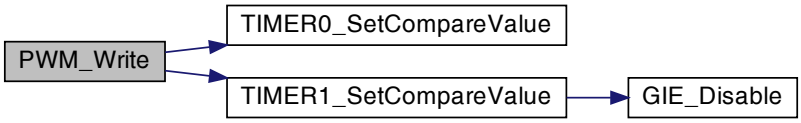


#### 5.59.2.17 PWM_Write() `void PWM_Write (`

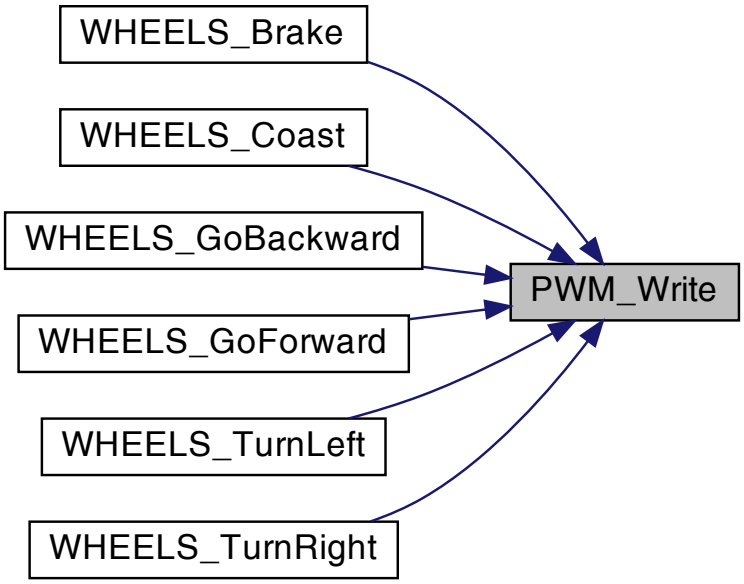
```
PWM_t channel,
u8 dutyPercentage )
```

Definition at line 793 of file TIMER.c.

Here is the call graph for this function:




Here is the caller graph for this function:




#### 5.59.2.18 TIMER0_DisableCompareMatchInterrupt() `void TIMER0_DisableCompareMatchInterrupt (`

```
void )
```

Definition at line 565 of file TIMER.c.

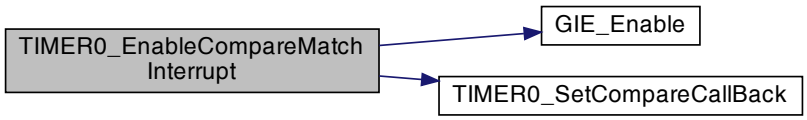
#### 5.59.2.19 TIMER0_DisableOverflowInterrupt() void TIMER0_DisableOverflowInterrupt ( void )

Definition at line 550 of file TIMER.c.

#### 5.59.2.20 TIMER0_EnableCompareMatchInterrupt() void TIMER0_EnableCompareMatchInterrupt ( void(*)(void) *callBackPtr* )

Definition at line 555 of file TIMER.c.

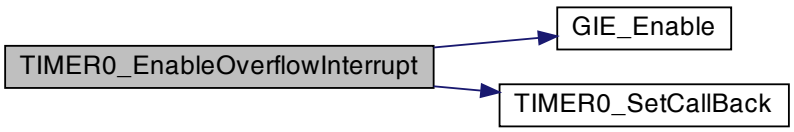
Here is the call graph for this function:




#### 5.59.2.21 TIMER0_EnableOverflowInterrupt() void TIMER0_EnableOverflowInterrupt ( void(*)(void) *callBackPtr* )

Definition at line 540 of file TIMER.c.

Here is the call graph for this function:




#### 5.59.2.22 TIMER0_GetTimerValue() u8 TIMER0_GetTimerValue ( void )

Definition at line 570 of file TIMER.c.

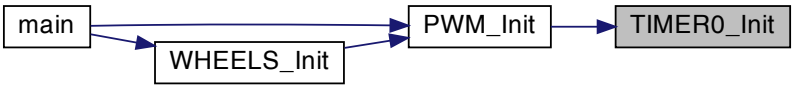
#### 5.59.2.23 TIMER0_Init() `void TIMER0_Init (`

```
u8 initValue,
TIMER_CLOCK_t clock,
TIMER_MODE_t timerMode,
TIMER_OC_t compareMode )
```

TIMER0 Implementations

Definition at line 518 of file TIMER.c.

Here is the caller graph for this function:

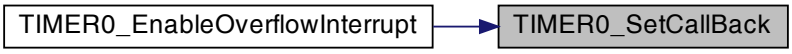



#### 5.59.2.24 TIMER0_SetCallBack() `void TIMER0_SetCallBack (`

```
void(*)(void) ptr )
```

Definition at line 37 of file TIMER.c.

Here is the caller graph for this function:

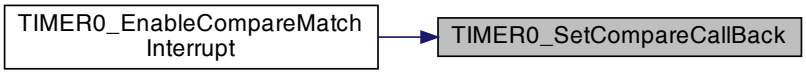



#### 5.59.2.25 TIMER0_SetCompareCallBack() `void TIMER0_SetCompareCallBack (`

```
void(*)(void) ptr )
```

Definition at line 42 of file TIMER.c.

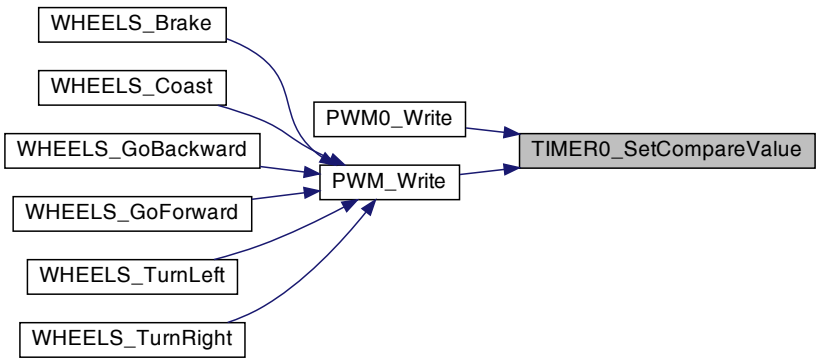
Here is the caller graph for this function:



#### 5.59.2.26 TIMER0_SetCompareValue() void TIMER0_SetCompareValue ( u8 u8CompareValue )

Definition at line 532 of file TIMER.c.

Here is the caller graph for this function:




#### 5.59.2.27 TIMER0_SetTimer() void TIMER0_SetTimer ( u8 u8TimerValue )

Definition at line 536 of file TIMER.c.

#### 5.59.2.28 TIMER1_DisableCaptureInterrupt() void TIMER1_DisableCaptureInterrupt ( void )

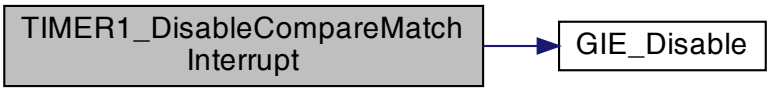
Definition at line 724 of file TIMER.c.

Here is the call graph for this function:

#### 5.59.2.29 TIMER1_DisableCompareMatchInterrupt() `void TIMER1_DisableCompareMatchInterrupt ( TIMER_OCx_t OCx )`

Definition at line 692 of file TIMER.c.

Here is the call graph for this function:




#### 5.59.2.30 TIMER1_DisableOverflowInterrupt() `void TIMER1_DisableOverflowInterrupt ( void )`

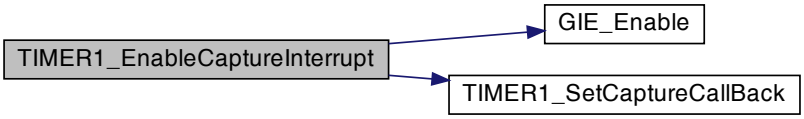
Definition at line 659 of file TIMER.c.

Here is the call graph for this function:


#### 5.59.2.31 TIMER1_EnableCaptureInterrupt() `void TIMER1_EnableCaptureInterrupt ( void(*)(void) callBackPtr )`

Definition at line 714 of file TIMER.c.

Here is the call graph for this function:

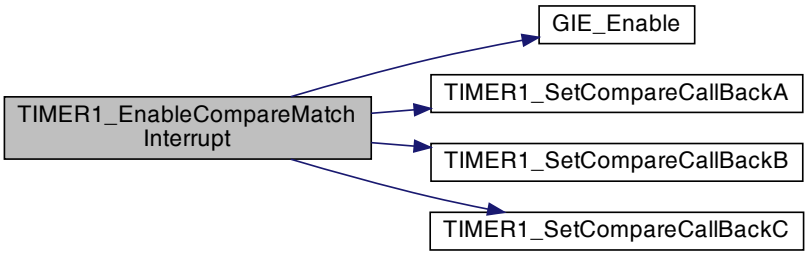


#### 5.59.2.32 TIMER1_EnableCompareMatchInterrupt()

```
void TIMER1_EnableCompareMatchInterrupt (
    TIMER_OCx_t OCx,
    void(*)(void) callBackPtr )
```

Definition at line 670 of file TIMER.c.

Here is the call graph for this function:

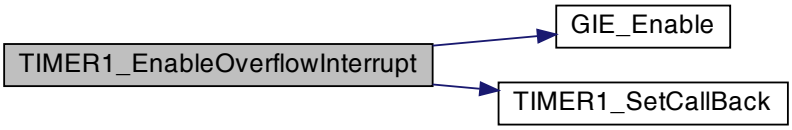



#### 5.59.2.33 TIMER1_EnableOverflowInterrupt()

```
void TIMER1_EnableOverflowInterrupt (
    void(*)(void) callBackPtr )
```

Definition at line 649 of file TIMER.c.

Here is the call graph for this function:

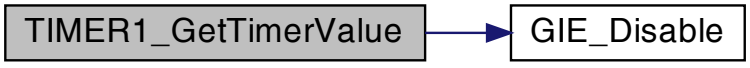



#### 5.59.2.34 TIMER1_GetTimerValue()

```
u16 TIMER1_GetTimerValue (
    void  )
```

Definition at line 735 of file TIMER.c.

Here is the call graph for this function:



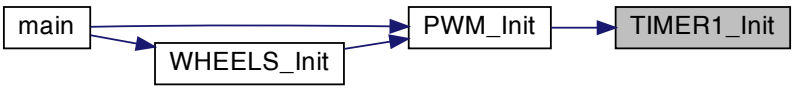
#### 5.59.2.35 TIMER1_Init()

```
void TIMER1_Init (
    u16 initValue,
    TIMER_CLOCK_t clock,
    TIMER_MODE_t timerMode,
    TIMER_OC_t compareMode,
    TIMER_OCx_t OCx )
```

TIMER1 Implementations

Definition at line 585 of file TIMER.c.

Here is the caller graph for this function:

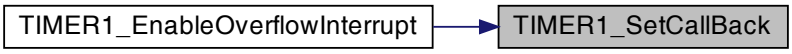



#### 5.59.2.36 TIMER1_SetCallBack()

```
void TIMER1_SetCallBack (
    void(*)(void) ptr )
```

Definition at line 47 of file TIMER.c.

Here is the caller graph for this function:

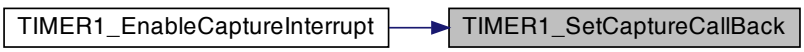



#### 5.59.2.37 TIMER1_SetCaptureCallBack()

```
void TIMER1_SetCaptureCallBack (
    void(*)(void) ptr )
```

Definition at line 67 of file TIMER.c.

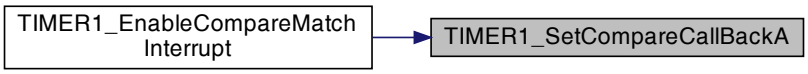
Here is the caller graph for this function:



#### 5.59.2.38 TIMER1_SetCompareCallBackA() `void TIMER1_SetCompareCallBackA ( void(*)(void) ptr )`

Definition at line 52 of file TIMER.c.

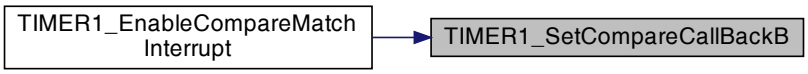
Here is the caller graph for this function:




#### 5.59.2.39 TIMER1_SetCompareCallBackB() `void TIMER1_SetCompareCallBackB ( void(*)(void) ptr )`

Definition at line 57 of file TIMER.c.

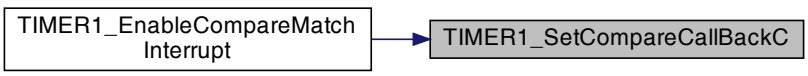
Here is the caller graph for this function:




#### 5.59.2.40 TIMER1_SetCompareCallBackC() `void TIMER1_SetCompareCallBackC ( void(*)(void) ptr )`

Definition at line 62 of file TIMER.c.

Here is the caller graph for this function:

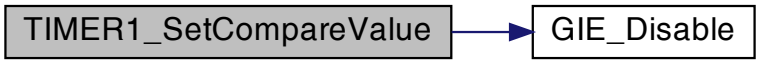


#### 5.59.2.41 TIMER1_SetCompareValue()

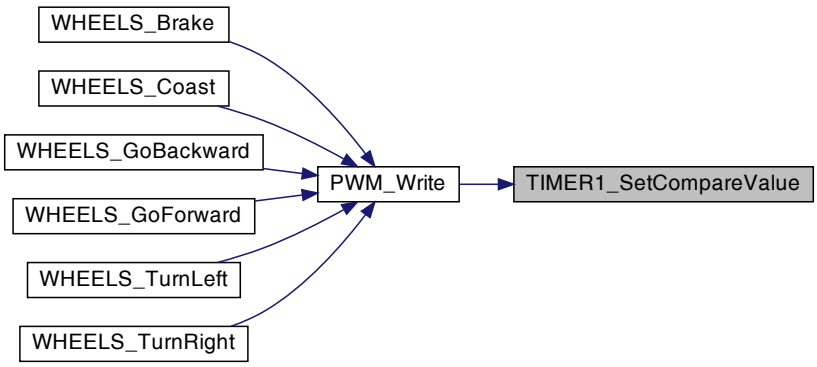
```
void TIMER1_SetCompareValue (
    u16 u16CompareValue,
    TIMER_OCx_t OCx )
```

Definition at line 613 of file TIMER.c.

Here is the call graph for this function:




Here is the caller graph for this function:

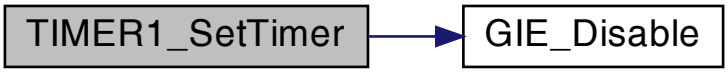



#### 5.59.2.42 TIMER1_SetTimer()

```
void TIMER1_SetTimer (
    u16 u16TimerValue )
```

Definition at line 638 of file TIMER.c.

Here is the call graph for this function:



#### 5.59.2.43 TIMER2_SetCallBack()

```
void TIMER2_SetCallBack (
    void(*)(void) ptr )
```

Definition at line 72 of file TIMER.c.

#### 5.59.2.44 TIMER2_SetCompareCallBack()

```
void TIMER2_SetCompareCallBack (
    void(*)(void) ptr )
```

Definition at line 77 of file TIMER.c.

#### 5.59.2.45 TIMER3_SetCallBack()

```
void TIMER3_SetCallBack (
    void(*)(void) ptr )
```

Definition at line 82 of file TIMER.c.

#### 5.59.2.46 TIMER3_SetCaptureCallBack()

```
void TIMER3_SetCaptureCallBack (
    void(*)(void) ptr )
```

Definition at line 102 of file TIMER.c.

#### 5.59.2.47 TIMER3_SetCompareCallBackA()

```
void TIMER3_SetCompareCallBackA (
    void(*)(void) ptr )
```

Definition at line 87 of file TIMER.c.

#### 5.59.2.48 TIMER3_SetCompareCallBackB()

```
void TIMER3_SetCompareCallBackB (
    void(*)(void) ptr )
```

Definition at line 92 of file TIMER.c.

#### 5.59.2.49 TIMER3_SetCompareCallBackC()

```
void TIMER3_SetCompareCallBackC (
    void(*)(void) ptr )
```

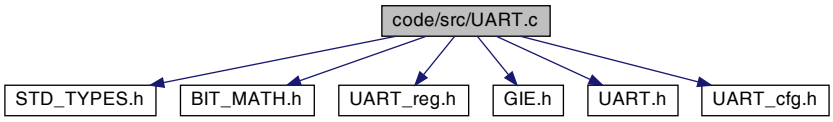
Definition at line 97 of file TIMER.c.

## 5.60 code/src/UART.c File Reference

UART driver for ATMEGA128 microcontroller.

```
#include "STD_TYPES.h"
#include "BIT_MATH.h"
#include "UART_reg.h"
#include "GIE.h"
#include "UART.h"
#include "UART_cfg.h"
```

Include dependency graph for UART.c:




### Typedefs

- typedef void(∗volatile UART_Callback_typedef_fn) (void)

### Functions

- void __vector_18 (void)
- void __vector_20 (void)
- void __vector_19 (void)
- void __vector_30 (void)
- void __vector_32 (void)
- void __vector_31 (void)
- void UART0_Init (void)

  *Initialize UART module 0 as configured in UART_cfg.h and UART_cfg.c.*
- void UART1_Init (void)

  *Initialize UART module 1 as configured in UART_cfg.h and UART_cfg.c.*
- void UART0_Enable (void)

  *Enable UART module 0 if it is disabled previously by UART0_Disable()*
- void UART1_Enable (void)

  *Enable UART module 1 if it is disabled previously by UART1_Disable()*
- void UART0_Disable (void)

  *Disable UART module 0 if it is enabled.*
- void UART1_Disable (void)

  *Disable UART module 1 if it is enabled.*
- void UART0_SendByte (const u8 data)

  *Send a byte using UART module 0 Synchronously.*
- void UART1_SendByte (const u8 data)

  *Send a byte using UART module 1.*
- void UART0_Send9BitData (const u16 data)

  *Send 9 bits using UART module 0.*
- void UART1_Send9BitData (const u16 data)

*Send 9 bits using UART module 1.*

- void UART0_SendByte_NoBlock (const u8 data)

  *Send a byte using UART module 0 Asynchronously.*
- void UART1_SendByte_NoBlock (const u8 data)

  *Send a byte using UART module 1 Asynchronously.*
- void UART0_Send9BitData_NoBlock (const u16 data)

  *Send 9 bits using UART module 0 Asynchronously.*
- void UART1_Send9BitData_NoBlock (const u16 data)

  *Send 9 bits using UART module 1 Asynchronously.*
- ERROR_STATUS_t UART0_ReceiveByte (u8 *const data)

  *Receive a byte using UART module 0.*
- ERROR_STATUS_t UART1_ReceiveByte (u8 *const data)

  *Receive a byte using UART module 1.*
- ERROR_STATUS_t UART0_Receive9BitData (u16 *const data)

  *Receive a string of 16 bits using UART module 0 (9 bits data)*
- ERROR_STATUS_t UART1_Receive9BitData (u16 *const data)

  *Receive a string of 16 bits using UART module 1 (9 bits data)*
- ERROR_STATUS_t UART0_ReceiveByte_NoBlock (u8 *const data)

  *Receive a byte using UART module 0 Asynchronously.*
- ERROR_STATUS_t UART1_ReceiveByte_NoBlock (u8 *const data)

  *Receive a byte using UART module 1 Asynchronously.*
- ERROR_STATUS_t UART0_Receive9BitData_NoBlock (u16 *const data)
- ERROR_STATUS_t UART1_Receive9BitData_NoBlock (u16 *const data)
- STATE_t UART0_Available (void)

  *Check if there is a byte available in UART module 0.*
- STATE_t UART1_Available (void)

  *Check if there is a byte available in UART module 1.*
- void UART0_Flush (void)

  *The receiver buffer FIFO will be flushed when the receiver is disabled, i.e. the buffer will be emptied of its contents. Unread data will be lost. If the buffer has to be flushed during normal operation, due to for instance an error condition, read the UDR I/O location until the RXC flag is cleared.*
- void UART1_Flush (void)

  *Flush the receive buffer of UART module 1.*
- void UART0_RX_InterruptEnable (void(*const ptrCallback)(void))

  *Enable the receive interrupt of UART module 0 with passing the function pointer to the interrupt service routine.*
- void UART1_RX_InterruptEnable (void(*const ptrCallback)(void))

  *Enable the receive interrupt of UART module 1 with passing the function pointer to the interrupt service routine.*
- void UART1_TX_InterruptEnable (void(*const ptrCallback)(void))

  *Enable the transmit interrupt of UART module 0 with passing the function pointer to the interrupt service routine.*
- void UART0_TX_InterruptEnable (void(*const ptrCallback)(void))

  *Enable the transmit interrupt of UART module 1 with passing the function pointer to the interrupt service routine.*
- void UART0_UDRE_InterruptEnable (void(*const ptrCallback)(void))

  *Enable the interrupt of Data Register Empty of UART module 0 with passing the function pointer to the interrupt service routine.*
- void UART1_UDRE_InterruptEnable (void(*const ptrCallback)(void))

  *Enable the interrupt of Data Register Empty of UART module 1 with passing the function pointer to the interrupt service routine.*
- void UART0_RX_InterruptDisable (void)

  *Disable the receive interrupt of UART module 0.*
- void UART1_RX_InterruptDisable (void)

  *Disable the receive interrupt of UART module 1.*
- void UART0_TX_InterruptDisable (void)

*Disable the transmit interrupt of UART module 0.*

- void UART1_TX_InterruptDisable (void)

  *Disable the transmit interrupt of UART module 1.*

- void UART0_UDRE_InterruptDisable (void)

  *Disable the interrupt of Data Register Empty of UART module 0.*

- void UART1_UDRE_InterruptDisable (void)

  *Disable the interrupt of Data Register Empty of UART module 1.*

### 5.60.1 Detailed Description

UART driver for ATMEGA128 microcontroller.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-03

**Copyright**

Copyright (c) 2022

### 5.60.2 Typedef Documentation

#### 5.60.2.1 UART_Callback_typedef_fn `typedef void(* volatile UART_Callback_typedef_fn) (void)`

Definition at line 27 of file UART.c.

### 5.60.3 Function Documentation

#### 5.60.3.1 __vector_18() `void __vector_18 ( void )`

Definition at line 40 of file UART.c.

#### 5.60.3.2 __vector_19() void __vector_19 ( void )

Definition at line 70 of file UART.c.

#### 5.60.3.3 __vector_20() void __vector_20 ( void )

Definition at line 55 of file UART.c.

#### 5.60.3.4 __vector_30() void __vector_30 ( void )

Definition at line 85 of file UART.c.

#### 5.60.3.5 __vector_31() void __vector_31 ( void )

Definition at line 115 of file UART.c.

#### 5.60.3.6 __vector_32() void __vector_32 ( void )

Definition at line 100 of file UART.c.

#### 5.60.3.7 UART0_Available() STATE_t UART0_Available ( void )

Check if there is a byte available in UART module 0.

**Returns**

HIGH if there is a byte available, LOW otherwise

Definition at line 625 of file UART.c.

Here is the caller graph for this function:

#### 5.60.3.8 UART0_Disable() `void UART0_Disable (`

```
void )
```

Disable UART module 0 if it is enabled.

Definition at line 546 of file UART.c.

#### 5.60.3.9 UART0_Enable() `void UART0_Enable (`

```
void )
```

Enable UART module 0 if it is disabled previously by UART0_Disable()

Definition at line 535 of file UART.c.

#### 5.60.3.10 UART0_Flush() `void UART0_Flush (`

```
void )
```

The receiver buffer FIFO will be flushed when the receiver is disabled, i.e. the buffer will be emptied of its contents. Unread data will be lost. If the buffer has to be flushed during normal operation, due to for instance an error condition, read the UDR I/O location until the RXC flag is cleared.

Flush the receive buffer of UART module 0.

Definition at line 640 of file UART.c.

#### 5.60.3.11 UART0_Init() `void UART0_Init (`

```
void )
```

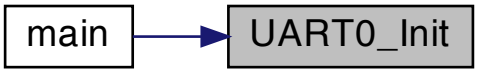
Initialize UART module 0 as configured in UART_cfg.h and UART_cfg.c.

**It configure UART module 0 accorfing to UART_cfg.h and UART_cfg.c**

and then enable UART module 0

Definition at line 482 of file UART.c.

Here is the caller graph for this function:



#### 5.60.3.12 UART0_Receive9BitData() ERROR_STATUS_t UART0_Receive9BitData ( u16 * data )

Receive a string of 16 bits using UART module 0 (9 bits data)

**For Example: UART0_Receive9BitString(string); will receive a string of 16 bits**

from UART module 0 and store it in variable <string>

**Returns**

The error code: ERROR_NO if no error, ERROR_YES if error

Definition at line 599 of file UART.c.

#### 5.60.3.13 UART0_Receive9BitData_NoBlock() ERROR_STATUS_t UART0_Receive9BitData_NoBlock ( u16 *const data )

Definition at line 616 of file UART.c.

#### 5.60.3.14 UART0_ReceiveByte() ERROR_STATUS_t UART0_ReceiveByte ( u8 * data )

Receive a byte using UART module 0.

**For Example: UART0_ReceiveByte(&data); will receive a byte from UART module 0**

and store it in variable <data>

**Returns**

The error code: ERROR_NO if no error, ERROR_YES if error

Definition at line 591 of file UART.c.

Here is the caller graph for this function:

#### 5.60.3.15 UART0_ReceiveByte_NoBlock() `ERROR_STATUS_t UART0_ReceiveByte_NoBlock ( u8 * data )`

Receive a byte using UART module 0 Asynchronously.

**For Example: UART0_ReceiveByte(&data); will receive a byte from UART module 0**

and store it in variable <data> without checking receive complete flag and without blocking the calling thread

**Returns**

The error code: ERROR_NO if no error, ERROR_YES if error

Definition at line 608 of file UART.c.

#### 5.60.3.16 UART0_RX_InterruptDisable() `void UART0_RX_InterruptDisable ( void )`

Disable the receive interrupt of UART module 0.

**For Example: UART0_RX_InterruptDisable(); will disable the receive interrupt**

of UART module 0

Definition at line 714 of file UART.c.

#### 5.60.3.17 UART0_RX_InterruptEnable() `void UART0_RX_InterruptEnable ( void(*)(void) ptrCallback )`

Enable the receive interrupt of UART module 0 with passing the function pointer to the interrupt service routine.

**Parameters**

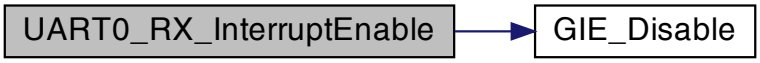
| | | |
|---|---|---|
| in | *ptrCallback* | Pointer to the interrupt service routine |

**Note**

The interrupt is triggered when a byte is received

Definition at line 648 of file UART.c.

Here is the call graph for this function:




#### 5.60.3.18 UART0_Send9BitData() `void UART0_Send9BitData ( const u16 data )`

Send 9 bits using UART module 0.

**For Example: UART0_Send9Bits(0x123); will send 9 bits 0x123 to UART module 0**

Definition at line 565 of file UART.c.

#### 5.60.3.19 UART0_Send9BitData_NoBlock() `void UART0_Send9BitData_NoBlock ( const u16 data )`

Send 9 bits using UART module 0 Asynchronously.

**For Example: UART0_Send9Bits_NoBlock(0x123); will send 9 bits 0x123 to UART module 0**

without blocking the calling thread

Definition at line 582 of file UART.c.

#### 5.60.3.20 UART0_SendByte() `void UART0_SendByte ( const u8 data )`

Send a byte using UART module 0 Synchronously.

**For Example: UART0_SendByte('a'); will send character 'a' to UART module 0**

Definition at line 557 of file UART.c.

Here is the caller graph for this function:


#### 5.60.3.21 UART0_SendByte_NoBlock() `void UART0_SendByte_NoBlock ( const u8 data )`

Send a byte using UART module 0 Asynchronously.

**For Example: UART0_SendByte_NoBlock('a'); will send character 'a' to UART module 0**

without blocking the calling thread

Definition at line 574 of file UART.c.

#### 5.60.3.22 UART0_TX_InterruptDisable() `void UART0_TX_InterruptDisable ( void )`

Disable the transmit interrupt of UART module 0.

**For Example: UART0_TX_InterruptDisable(); will disable the transmit interrupt**

of UART module 0

Definition at line 722 of file UART.c.

#### 5.60.3.23 UART0_TX_InterruptEnable() `void UART0_TX_InterruptEnable ( void(*)(void) ptrCallback )`

Enable the transmit interrupt of UART module 1 with passing the function pointer to the interrupt service routine.

**Parameters**

| | | |
|---|---|---|
| in | *ptrCallback* | Pointer to the interrupt service routine |

**Note**

The transmit interrupt will be triggered after transmission complete.

Definition at line 681 of file UART.c.

Here is the call graph for this function:


#### 5.60.3.24 UART0_UDRE_InterruptDisable() `void UART0_UDRE_InterruptDisable ( void )`

Disable the interrupt of Data Register Empty of UART module 0.

**For Example: UART0_UDRE_InterruptDisable(); will disable the interrupt**

of Data Register Empty of UART module 0

Definition at line 730 of file UART.c.

#### 5.60.3.25 UART0_UDRE_InterruptEnable() `void UART0_UDRE_InterruptEnable ( void(*)(void) ptrCallback )`

Enable the interrupt of Data Register Empty of UART module 0 with passing the function pointer to the interrupt service routine.

**Parameters**

| | | |
|---|---|---|
| in | *ptrCallback* | Pointer to the interrupt service routine |

**Note**

The interrupt is triggered when the data register is empty

Definition at line 692 of file UART.c.

Here is the call graph for this function:


#### 5.60.3.26 UART1_Available() `STATE_t UART1_Available ( void )`

Check if there is a byte available in UART module 1.

**Returns**

HIGH if there is a byte available, LOW otherwise

Definition at line 629 of file UART.c.

Here is the caller graph for this function:


#### 5.60.3.27 UART1_Disable() `void UART1_Disable ( void )`

Disable UART module 1 if it is enabled.

Definition at line 551 of file UART.c.

#### 5.60.3.28 UART1_Enable() `void UART1_Enable ( void )`

Enable UART module 1 if it is disabled previously by UART1_Disable()

**It enable UART module 1 if it is disabled previously by UART1_Disable()**

Definition at line 540 of file UART.c.

#### 5.60.3.29 UART1_Flush() `void UART1_Flush ( void )`

Flush the receive buffer of UART module 1.

**For Example: UART1_Flush(); will flush the receive buffer of UART module 1**

Definition at line 644 of file UART.c.

#### 5.60.3.30 UART1_Init() `void UART1_Init ( void )`

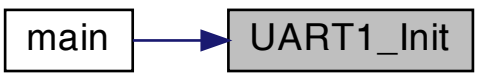
Initialize UART module 1 as configured in UART_cfg.h and UART_cfg.c.

**It configure UART module 1 accorfing to UART_cfg.h and UART_cfg.c**

and then enable UART module 1

Definition at line 508 of file UART.c.

Here is the caller graph for this function:



#### 5.60.3.31 UART1_Receive9BitData() ERROR_STATUS_t UART1_Receive9BitData ( u16 * data )

Receive a string of 16 bits using UART module 1 (9 bits data)

**For Example: UART1_Receive9BitString(string); will receive a string of 16 bits**

from UART module 1 and store it in variable <string>

**Returns**

The error code: ERROR_NO if no error, ERROR_YES if error

Definition at line 603 of file UART.c.

#### 5.60.3.32 UART1_Receive9BitData_NoBlock() ERROR_STATUS_t UART1_Receive9BitData_NoBlock ( u16 *const data )

Definition at line 620 of file UART.c.

#### 5.60.3.33 UART1_ReceiveByte() ERROR_STATUS_t UART1_ReceiveByte ( u8 * data )

Receive a byte using UART module 1.

**For Example: UART1_ReceiveByte(&data); will receive a byte from UART module 1**

and store it in variable <data>

**Returns**

The error code: ERROR_NO if no error, ERROR_YES if error

Definition at line 595 of file UART.c.

Here is the caller graph for this function:

#### 5.60.3.34 UART1_ReceiveByte_NoBlock() ERROR_STATUS_t UART1_ReceiveByte_NoBlock ( u8 * data )

Receive a byte using UART module 1 Asynchronously.

**For Example: UART1_ReceiveByte(&data); will receive a byte from UART module 1**

and store it in variable <data> without checking receive complete flag and without blocking the calling thread

**Returns**

The error code: ERROR_NO if no error, ERROR_YES if error

Definition at line 612 of file UART.c.

#### 5.60.3.35 UART1_RX_InterruptDisable() void UART1_RX_InterruptDisable ( void )

Disable the receive interrupt of UART module 1.

**For Example: UART1_RX_InterruptDisable(); will disable the receive interrupt**

of UART module 1

Definition at line 718 of file UART.c.

#### 5.60.3.36 UART1_RX_InterruptEnable() void UART1_RX_InterruptEnable ( void(*)(void) ptrCallback )

Enable the receive interrupt of UART module 1 with passing the function pointer to the interrupt service routine.

**Parameters**

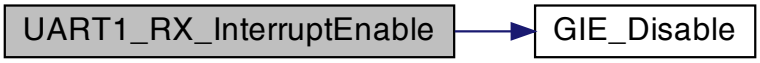
| | | |
|---|---|---|
| in | *ptrCallback* | Pointer to the interrupt service routine |

**Note**

The interrupt is triggered when a byte is received

Definition at line 659 of file UART.c.

Here is the call graph for this function:




#### 5.60.3.37 UART1_Send9BitData() `void UART1_Send9BitData ( const u16 data )`

Send 9 bits using UART module 1.

**Parameters**

| | | |
|---|---|---|
| in | *data* | 9 bits data to be sent. Should be between 0 and 0x1FF |

**Note**

Size of data should be 2 Bytes to be able to send 9 bits data

**For Example: UART1_Send9Bits(0x123); will send 9 bits 0x123 to UART module 1**

Definition at line 569 of file UART.c.

#### 5.60.3.38 UART1_Send9BitData_NoBlock() `void UART1_Send9BitData_NoBlock ( const u16 data )`

Send 9 bits using UART module 1 Asynchronously.

**Parameters**

| | | |
|---|---|---|
| in | *data* | 9 bits data to be sent. Should be between 0 and 0x1FF |

**Note**

Size of data should be 2 Bytes to be able to send 9 bits data

**For Example: UART1_Send9Bits_NoBlock(0x123); will send 9 bits 0x123 to UART module 1**

without blocking the calling thread

Definition at line 586 of file UART.c.

#### 5.60.3.39 UART1_SendByte() `void UART1_SendByte (`

```
const u8 data )
```

Send a byte using UART module 1.

**For Example: UART1_SendByte('y'); will send character 'y' to UART module 1**

Definition at line 561 of file UART.c.

Here is the caller graph for this function:


#### 5.60.3.40 UART1_SendByte_NoBlock() `void UART1_SendByte_NoBlock (`

```
const u8 data )
```

Send a byte using UART module 1 Asynchronously.

**For Example: UART1_SendByte_NoBlock('a'); will send character 'a' to UART module 1**

without blocking the calling thread

Definition at line 578 of file UART.c.

#### 5.60.3.41 UART1_TX_InterruptDisable() `void UART1_TX_InterruptDisable (`

```
void )
```

Disable the transmit interrupt of UART module 1.

**For Example: UART1_TX_InterruptDisable(); will disable the transmit interrupt**

of UART module 1

Definition at line 726 of file UART.c.

#### 5.60.3.42 UART1_TX_InterruptEnable() `void UART1_TX_InterruptEnable (`

```
void(*)(void) ptrCallback )
```

Enable the transmit interrupt of UART module 0 with passing the function pointer to the interrupt service routine.

**Parameters**

| | | |
|---|---|---|
| in | *ptrCallback* | Pointer to the interrupt service routine |

**Note**

The transmit interrupt will be triggered after transmission complete.

Definition at line 670 of file UART.c.

Here is the call graph for this function:


#### 5.60.3.43 UART1_UDRE_InterruptDisable() `void UART1_UDRE_InterruptDisable ( void )`

Disable the interrupt of Data Register Empty of UART module 1.

**For Example: UART1_UDRE_InterruptDisable(); will disable the interrupt**

of Data Register Empty of UART module 1

Definition at line 734 of file UART.c.

#### 5.60.3.44 UART1_UDRE_InterruptEnable() `void UART1_UDRE_InterruptEnable ( void(*)(void) ptrCallback )`

Enable the interrupt of Data Register Empty of UART module 1 with passing the function pointer to the interrupt service routine.

**Parameters**

| | | |
|---|---|---|
| in | *ptrCallback* | Pointer to the interrupt service routine |

**Note**

The interrupt is triggered when the data register is empty

Definition at line 703 of file UART.c.

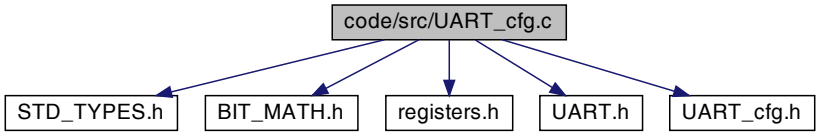
Here is the call graph for this function:


## 5.61 code/src/UART_cfg.c File Reference

Configuration source file for UART.c.

```
#include "STD_TYPES.h"
#include "BIT_MATH.h"
#include "registers.h"
#include "UART.h"
#include "UART_cfg.h"
```

Include dependency graph for UART_cfg.c:




### Variables

- UART_CFG_t UART0_Configs
- UART_CFG_t UART1_Configs

### 5.61.1 Detailed Description

Configuration source file for UART.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-03

**Copyright**

Copyright (c) 2022

### 5.61.2 Variable Documentation

#### 5.61.2.1 UART0_Configs `UART_CFG_t UART0_Configs`

**Initial value:**

```
= {
    .baud_rate  = 9600,
    .data_bits  = UART_DATA_8_BITS,
    .stop_bits  = UART_STOP_1_BIT,
    .parity     = UART_PARITY_DISABLE,
    .mode       = UART_MODE_ASYNCHRONOUS_NORMAL,
    .mode_type  = UART_MODE_TX_RX,
}
```

**Note**

Baud rate options:

- 2400UL --> 2400 bits per second
- 4800UL --> 4800 bits per second
- 9600UL --> 9600 bits per second
- 14400UL --> 14400 bits per second
- 19200UL --> 19200 bits per second
- 28800UL --> 28800 bits per second
- 38400UL --> 38400 bits per second
- 57600UL --> 57600 bits per second
- 76800UL --> 76800 bits per second
- 115200UL --> 115200 bits per second
- 230400UL --> 230400 bits per second
- 250000UL --> 250000 bits per second
- 500000UL --> 500000 bits per second
- 1000000UL --> 1000000 bits per second

Definition at line 34 of file UART_cfg.c.

#### 5.61.2.2 UART1_Configs `UART_CFG_t UART1_Configs`

**Initial value:**

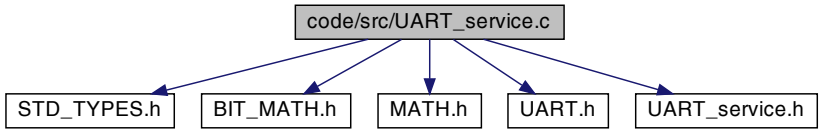
```
= {
    .baud_rate  = 9600,
    .data_bits  = UART_DATA_8_BITS,
    .stop_bits  = UART_STOP_1_BIT,
    .parity     = UART_PARITY_DISABLE,
    .mode       = UART_MODE_ASYNCHRONOUS_NORMAL,
    .mode_type  = UART_MODE_TX_RX,
}
```

Definition at line 43 of file UART_cfg.c.

## 5.62 code/src/UART_service.c File Reference

```
#include "STD_TYPES.h"
#include "BIT_MATH.h"
#include "MATH.h"
#include "UART.h"
#include "UART_service.h"
```

Include dependency graph for UART_service.c:




### Functions

- void UART0_SendString (const u8 *const string)

  *Send a string using UART module 0.*
- void UART1_SendString (const u8 *const string)

  *Send a string using UART module 1.*
- void UART0_Send9BitString (const u16 *const string)

  *Send a sequence of elements, each element has 9 bits, using UART module 0.*
- void UART1_Send9BitString (const u16 *const string)

  *Send a sequence of elements, each element has 9 bits, using UART module 1.*
- void UART0_SendString_Asynchronous (const u8 *const string)
- void UART1_SendString_Asynchronous (const u8 *const string)
- void UART0_Send9BitString_Asynchronous (const u16 *const string)
- void UART1_Send9BitString_Asynchronous (const u16 *const string)
- void UART0_SendString_Checksum (const u8 *const string)
- void UART1_SendString_Checksum (const u8 *const string)
- void UART0_SendInteger (s32 integer)

  *Write Integer to UART0 as a string.*
- void UART1_SendInteger (s32 integer)

  *Write Integer to UART1 as a string.*
- void UART0_SendFloat (const float number, const u8 precision)

  *Write Float to UART0 as a string.*
- void UART1_SendFloat (const float number, const u8 precision)

  *Write Float to UART1 as a string.*
- ERROR_STATUS_t UART0_ReceiveString (u8 *const string)

  *Receive a string of characters (unsigned 8 bits data) using UART module 0.*
- ERROR_STATUS_t UART1_ReceiveString (u8 *const string)

  *Receive a string of characters (unsigned 8 bits data) using UART module 1.*
- ERROR_STATUS_t UART0_Receive9BitString (u16 *const string)

  *Receive a string of elements, each element has 9 bits, using UART module 0.*
- ERROR_STATUS_t UART1_Receive9BitString (u16 *const string)

  *Receive a string of elements, each element has 9 bits, using UART module 1.*
- ERROR_STATUS_t UART0_ReceiveString_Checksum (u8 *const string)
- ERROR_STATUS_t UART1_ReceiveString_Checksum (u8 *const string)

### 5.62.1 Function Documentation

#### 5.62.1.1 UART0_Receive9BitString() ERROR_STATUS_t UART0_Receive9BitString ( u16 *const string )

Receive a string of elements, each element has 9 bits, using UART module 0.

**Parameters**

| | | |
|---|---|---|
| in | *string* | Pointer to the first element of the sequence (pointer to 16 bits) |

**Note**

Size of each element should be 2 Bytes to be able to receive 9 bits data

**For Example: UART0_Receive9BitDataSequence(string); will receive elements of 9 bits**

each from UART module 0.

**Warning**

The sequence will be ended with a NULL pointer(0): The last element of the sequence will be a NULL pointer. So, consider the length of the sequence as strlen(string) + 1.

Definition at line 394 of file UART_service.c.

#### 5.62.1.2 UART0_ReceiveString() ERROR_STATUS_t UART0_ReceiveString ( u8 *const string )

Receive a string of characters (unsigned 8 bits data) using UART module 0.

**For Example: UART0_ReceiveString(string); will receive a string of characters**

from UART module 0 and store it in variable <string>

**Returns**

The error code: ERROR_NO if no error, ERROR_YES if error

**Warning**

The string will be null terminated. So, the last character will be '\0'. So, the length of the string should be strlen(string) + 1.

Definition at line 386 of file UART_service.c.

Here is the caller graph for this function:


#### 5.62.1.3 UART0_ReceiveString_Checksum()

```
ERROR_STATUS_t UART0_ReceiveString_Checksum (
        u8 *const string )
```

Definition at line 403 of file UART_service.c.

Here is the caller graph for this function:


#### 5.62.1.4 UART0_Send9BitString()

```
void UART0_Send9BitString (
        const u16 *const string )
```

Send a sequence of elements, each element has 9 bits, using UART module 0.

**Parameters**

| | | |
|---|---|---|
| in | *string* | Pointer to the first element of the sequence |

**Note**

Size of each element should be 2 Bytes to be able to send 9 bits data

**For Example: UART0_Send9BitDataSequence(string); will send elements of 9 bits**

each to UART module 0.

**Note**

The sequence should be ended with a NULL pointer(0): The last element of the sequence should be a NULL pointer.

But if you are sending an array, you must explicitly null terminate it by adding '\0' at the end of the array --> string[lenght-1] = '\0'

Definition at line 331 of file UART_service.c.

#### 5.62.1.5 UART0_Send9BitString_Asynchronous()

```
void UART0_Send9BitString_Asynchronous (
        const u16 *const string )
```

Definition at line 349 of file UART_service.c.

#### 5.62.1.6 UART0_SendFloat()

```
void UART0_SendFloat (
        float number,
        const u8 precision )
```

Write Float to UART0 as a string.

**Parameters**

| | | |
|---|---|---|
| in | *number* | The number to be written |

**For Example:**

- UART0_WriteFloat(123.456, 3) will write the string "123.456" to UART0
- UART0_WriteFloat(123.456, 2) will write the string "123.45" to UART0
- UART0_WriteFloat(123.456, 5) will write the string "123.45600" to UART0
- UART0_WriteFloat(-123.456, 3) will write the string "-123.456" to UART0
- UART0_WriteFloat(-123.456, 2) will write the string "-123.45" to UART0
- UART0_WriteFloat(-123.456, 5) will write the string "-123.45600" to UART0

Definition at line 377 of file UART_service.c.

#### 5.62.1.7 UART0_SendInteger() void UART0_SendInteger ( s32 integer )

Write Integer to UART0 as a string.

**Parameters**

| | | |
|---|---|---|
| in | *integer* | The integer to be written |

**For Example:**

- UART0_WriteInt(123) will write the string "123" to UART0
- UART0_WriteInt(-123) will write the string "-123" to UART0

Definition at line 368 of file UART_service.c.

Here is the caller graph for this function:


#### 5.62.1.8 UART0_SendString() `void UART0_SendString ( const u8 *const string )`

Send a string using UART module 0.

**For Example: UART0_SendString("Hello World"); will send string "Hello World" to UART module 0**

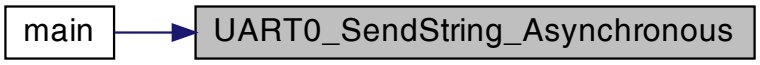
Definition at line 323 of file UART_service.c.

Here is the caller graph for this function:

#### 5.62.1.9 UART0_SendString_Asynchronous() `void UART0_SendString_Asynchronous ( const u8 *const string )`

Definition at line 340 of file UART_service.c.

Here is the caller graph for this function:




#### 5.62.1.10 UART0_SendString_Checksum() `void UART0_SendString_Checksum ( const u8 *const string )`

Definition at line 359 of file UART_service.c.

Here is the caller graph for this function:


#### 5.62.1.11 UART1_Receive9BitString() `ERROR_STATUS_t UART1_Receive9BitString ( u16 *const string )`

Receive a string of elements, each element has 9 bits, using UART module 1.

**Parameters**

| | | |
|---|---|---|
| in | *string* | Pointer to the first element of the sequence (pointer to 16 bits) |

**Note**

Size of each element should be 2 Bytes to be able to receive 9 bits data

**For Example: UART1_Receive9BitDataSequence(string); will receive elements of 9 bits**

each from UART module 1.

**Warning**

The sequence will be ended with a NULL pointer(0): The last element of the sequence will be a NULL pointer. So, consider the length of the sequence as strlen(string) + 1.

Definition at line 398 of file UART_service.c.

#### 5.62.1.12 UART1_ReceiveString()

```
ERROR_STATUS_t UART1_ReceiveString (
        u8 *const string )
```

Receive a string of characters (unsigned 8 bits data) using UART module 1.

**For Example: UART1_ReceiveString(string); will receive a string of characters**

from UART module 1 and store it in variable <string>

**Returns**

The error code: ERROR_NO if no error, ERROR_YES if error

**Warning**

The string will be null terminated. So, the last character will be '\0'. So, the length of the string should be strlen(string) + 1.

Definition at line 390 of file UART_service.c.

#### 5.62.1.13 UART1_ReceiveString_Checksum()

```
ERROR_STATUS_t UART1_ReceiveString_Checksum (
        u8 *const string )
```

Definition at line 407 of file UART_service.c.

#### 5.62.1.14 UART1_Send9BitString()

```
void UART1_Send9BitString (
        const u16 *const string )
```

Send a sequence of elements, each element has 9 bits, using UART module 1.

**Parameters**

| | | |
|---|---|---|
| in | *string* | Pointer to the first element of the sequence |

**Note**

Size of each element should be 2 Bytes to be able to send 9 bits data

**For Example: UART1_Send9BitDataSequence(string); will send elements of 9 bits**

each to UART module 1.

**Note**

The sequence should be ended with a NULL pointer(0): The last element of the sequence should be a NULL pointer.

But if you are sending an array, you must explicitly null terminate it by adding '\0' at the end of the array --> string[lenght-1] = '\0'

Definition at line 335 of file UART_service.c.

#### 5.62.1.15 UART1_Send9BitString_Asynchronous()

```
void UART1_Send9BitString_Asynchronous (
    const u16 *const string )
```

Definition at line 354 of file UART_service.c.

#### 5.62.1.16 UART1_SendFloat()

```
void UART1_SendFloat (
    float number,
    const u8 precision )
```

Write Float to UART1 as a string.

**Parameters**

| | | |
|---|---|---|
| in | *number* | The number to be written |

**For Example:**

- UART1_WriteFloat(123.456, 3) will write the string "123.456" to UART1
- UART1_WriteFloat(123.456, 2) will write the string "123.45" to UART1
- UART1_WriteFloat(123.456, 5) will write the string "123.45600" to UART1
- UART1_WriteFloat(-123.456, 3) will write the string "-123.456" to UART1
- UART1_WriteFloat(-123.456, 2) will write the string "-123.45" to UART1
- UART1_WriteFloat(-123.456, 5) will write the string "-123.45600" to UART1

Definition at line 381 of file UART_service.c.

Here is the caller graph for this function:


#### 5.62.1.17 UART1_SendInteger() `void UART1_SendInteger (`

`s32 integer )`

Write Integer to UART1 as a string.

**Parameters**

| | | |
|---|---|---|
| in | *integer* | The integer to be written |

**For Example:**

- UART1_WriteInt(123) will write the string "123" to UART1
- UART1_WriteInt(-123) will write the string "-123" to UART1

Definition at line 372 of file UART_service.c.

Here is the caller graph for this function:


#### 5.62.1.18 UART1_SendString() `void UART1_SendString (`

`const u8 *const string )`

Send a string using UART module 1.

**For Example: UART1_SendString("Hello World"); will send string "Hello World"**

to UART module 1.

**Note**

String must be null terminated: "Hello World\0". So, the last character must be '\0'.

Sending "Hello World" will send "Hello World\0" because it is null terminated implicitly. But if you are sending an array of characters, you must explicitly null terminate it by adding '\0' at the end of the array. --> string[lenght-1] = '\0'

Definition at line 327 of file UART_service.c.

Here is the caller graph for this function:


#### 5.62.1.19 UART1_SendString_Asynchronous()

```
void UART1_SendString_Asynchronous (
        const u8 *const string )
```

Definition at line 344 of file UART_service.c.

#### 5.62.1.20 UART1_SendString_Checksum()

```
void UART1_SendString_Checksum (
        const u8 *const string )
```

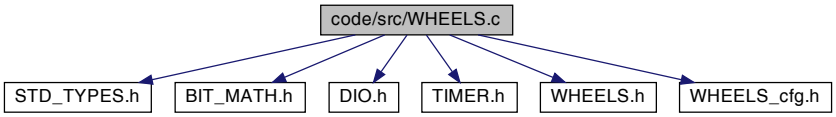
Definition at line 363 of file UART_service.c.

## 5.63 code/src/WHEELS.c File Reference

This is the source file for the WHEELS module based on the WHEELS module.

```
#include "STD_TYPES.h"
#include "BIT_MATH.h"
#include "DIO.h"
#include "TIMER.h"
#include "WHEELS.h"
#include "WHEELS_cfg.h"
```

Include dependency graph for WHEELS.c:



### Functions

- void WHEELS_Init (void)

  *Initialize the wheels module.*
- void WHEELS_GoForward (void)

  *Turn the wheels to go forward.*
- void WHEELS_GoBackward (void)

  *Turn the wheels to go backward.*
- void WHEELS_TurnLeft (const WHEELS_TURN_t smoothOrSharp)

  *Turn the wheels to turn left.*
- void WHEELS_TurnRight (const WHEELS_TURN_t smoothOrSharp)

  *Turn the wheels to turn right.*
- void WHEELS_Brake (void)

  *Brake the wheels.*
- void WHEELS_Coast (void)

  *Disables wheels and allows for free rolling.*
- void WHEELS_SetSpeed (const u8 Speed)

  *Set the speed of the wheels.*
- void WHEELS_SetWheelsPosition (const WHEELS_POSITION_t wheelsPositions)

  *Set the position of the wheels: on the front or on the back.*
- WHEELS_POSITION_t WHEELS_GetWheelsPosition (void)

  *Get the current position of the wheels.*

#### 5.63.1 Detailed Description

This is the source file for the WHEELS module based on the WHEELS module.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

This is the source file for the WHEELS module based on the WHEELS module. The WHEELS module is a module that controls the wheels of the robot. WHEELS is a dual H-bridge module that controls the motors of the robot.
There are 6 control pins: IN1A, IN2A, IN1B, IN2B, ENA, and ENB
There are 2 feadback pins: CTA and CTB.

- IN1A and IN2A control the speed of motor A. (PWM)
- IN1B and IN2B control the speed of motor B. (PWM)
- ENA enables the driver's output for motor A. (Digital)
- ENB enables the driver's output for motor B. (Digital)
  - CTA reports the current draw of motor A back to the microcontroller. (Analog)
- CTB reports the current draw of motor B back to the microcontroller. (Analog)

**Note**

The PWM frequency is recommended to be 16 kHz for normal motors, 80 kHz for Coreless motors.
CTA and CTB are Optional.

**Example:**

When IN1A is driven LOW and IN2A is provided a PWM signal, the motor will go in reverse. When IN1A is provided a PWM signal and IN2A is driven LOW, the motor will go forward.

**Warning**

The driver requires a maximum duty cycle on the PWM input of no more than 98%.
Any higher might damage the driver / result in instability.

Library usage:

```
Option 1:
    WHEELS.Init();  This will use the default pins

Option 2:
    WHEELS.init(IN1A, IN1B, IN2A, IN2B, ENA, ENB, CTA, CTB);      This will define which
        pins are used on the microcontroller.

Once defined the motor can be controlled by using:
WHEELS.GoForward();     Moves both motors forward
WHEELS.GoBackward();    Moves both motors reverse
```

WHEELS_TurnLeft(SMOOTH_TURN); Moves the left and right motors forward, but the left motor is slower than the right motor WHEELS_TurnRight(SMOOTH_TURN); Moves the left and right motors forward, but the right motor is slower than the left motor WHEELS_TurnLeft(SHARP_TURN); Moves the left motor backward and right motors forward WHEELS_TurnRight(SHARP_TURN); Moves the right motor backward and left motors forward WHEELS.Brake(); UNTESTED - USE WITH CAUTION WHEELS.Coast(); Disables motor output WHEELS_SetSpeed(x); Sets the speed of both motors to x WHEELS_SetWheelsPosition(WHEELS_ON↩_FRONT); Sets the wheels position on the front WHEELS_SetWheelsPosition(WHEELS_ON_BACK); Sets the wheels position on the back WHEELS_GetCurrentConsumption(); Returns the current consumption of the wheels

**Version**

1.0.0

**Date**

2022-02-09

**Copyright**

Copyright (c) 2022

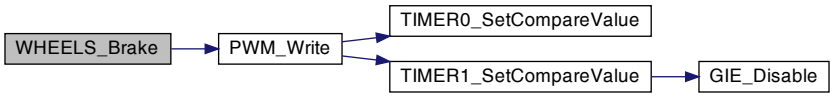
### 5.63.2 Function Documentation

#### 5.63.2.1 WHEELS_Brake() `void WHEELS_Brake ( void )`

Brake the wheels.

Definition at line 153 of file WHEELS.c.

Here is the call graph for this function:

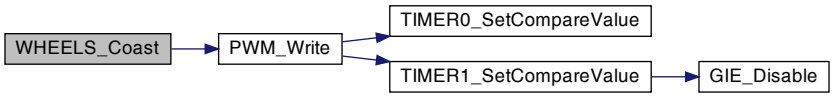


#### 5.63.2.2 WHEELS_Coast() `void WHEELS_Coast ( void )`

Disables wheels and allows for free rolling.

Definition at line 164 of file WHEELS.c.

Here is the call graph for this function:




#### 5.63.2.3 WHEELS_GetWheelsPosition() `WHEELS_POSITION_t WHEELS_GetWheelsPosition ( void )`

Get the current position of the wheels.

**Returns**

f32 The current consumption of the wheels in A.

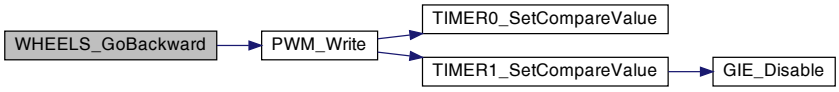
Definition at line 202 of file WHEELS.c.

#### 5.63.2.4 WHEELS_GoBackward() `void WHEELS_GoBackward ( void )`

Turn the wheels to go backward.

Definition at line 91 of file WHEELS.c.

Here is the call graph for this function:

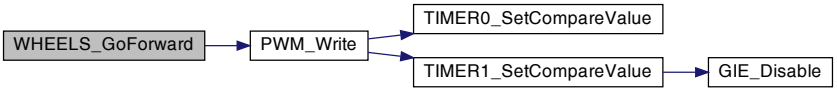


#### 5.63.2.5 WHEELS_GoForward() `void WHEELS_GoForward ( void )`

Turn the wheels to go forward.

Definition at line 79 of file WHEELS.c.

Here is the call graph for this function:

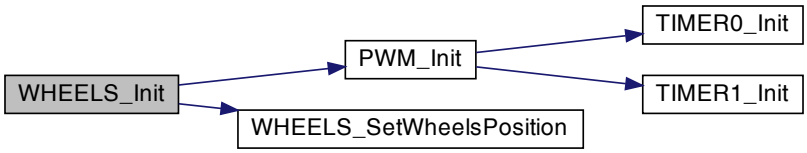



#### 5.63.2.6 WHEELS_Init() `void WHEELS_Init ( void )`

Initialize the wheels module.

Definition at line 68 of file WHEELS.c.

Here is the call graph for this function:




Here is the caller graph for this function:


#### 5.63.2.7 WHEELS_SetSpeed() `void WHEELS_SetSpeed ( u8 Speed )`

Set the speed of the wheels.

**Parameters**

| | | |
|---|---|---|
| in | *Speed* | The speed of the wheels. |

Definition at line 176 of file WHEELS.c.

#### 5.63.2.8 WHEELS_SetWheelsPosition() `void WHEELS_SetWheelsPosition ( WHEELS_POSITION_t wheelsPositions )`

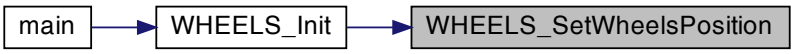
Set the position of the wheels: on the front or on the back.

**Parameters**

| | | |
|---|---|---|
| in | *wheelsPositions* | The poition of the wheels: WHEELS_ON_FRONT or WHEELS_ON_BACK. |

Definition at line 181 of file WHEELS.c.

Here is the caller graph for this function:

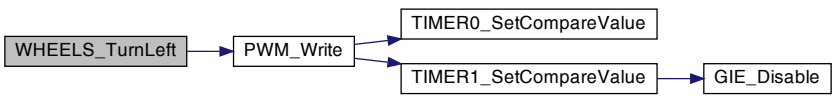



#### 5.63.2.9 WHEELS_TurnLeft() `void WHEELS_TurnLeft ( const WHEELS_TURN_t smoothOrSharp )`

Turn the wheels to turn left.

Definition at line 103 of file WHEELS.c.

Here is the call graph for this function:

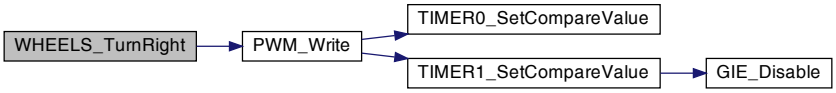


#### 5.63.2.10 WHEELS_TurnRight() void WHEELS_TurnRight ( const WHEELS_TURN_t *smoothOrSharp* )

Turn the wheels to turn right.

Definition at line 128 of file WHEELS.c.

Here is the call graph for this function:

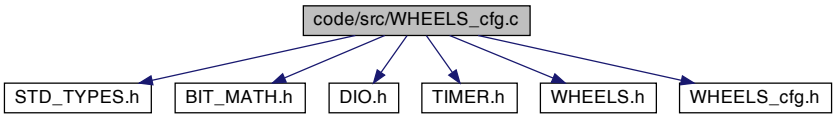



## 5.64 code/src/WHEELS_cfg.c File Reference

Configuration source file for WHEELS.c.

```
#include "STD_TYPES.h"
#include "BIT_MATH.h"
#include "DIO.h"
#include "TIMER.h"
#include "WHEELS.h"
#include "WHEELS_cfg.h"
```

Include dependency graph for WHEELS_cfg.c:




### Variables

- WHEELS_CONFIG_t WHEELS_Config

### 5.64.1 Detailed Description

Configuration source file for WHEELS.c.

**Author**

Mahmoud Karam ( ma.karam272@gmail.com)

**Version**

1.0.0

**Date**

2022-03-19

**Copyright**

### 5.64.2 Variable Documentation

#### 5.64.2.1 WHEELS_Config `WHEELS_CONFIG_t WHEELS_Config`

**Initial value:**

```
= {
    .ENA_pin    = PIN_3,
    .ENA_port   = PORT_G,
    .ENB_pin    = PIN_4,
    .ENB_port   = PORT_G,

    .IN1A_channel    = PWM_0,
    .IN2A_channel    = PWM_1,
    .IN1B_channel    = PWM_2,
    .IN2B_channel    = PWM_3,
    .CTA_pin    = PIN_6,
    .CTA_port   = PORT_A,
    .CTB_pin    = PIN_7,
    .CTB_port   = PORT_A,
    .currentSensitivity = 155,
    .SpeedPercentage    = 60,
    .WHEELS_Position    = WHEELS_ON_FRONT,
}
```

Definition at line 16 of file WHEELS_cfg.c.

# 6 Example Documentation

## 6.1 LED_Toggle

Toggle state of a specific LED

**Parameters**

| | | |
|---|---|---|
| in | *led* | the LED to be turned on/off (LED_0); |

# Index