# Firmware BRDQBRQBC = HFW2 documentation - qbcontrol main board

Generated by Doxygen 1.8.13

# Contents

# Chapter 1

# Firmware

This is the firmware of WFYD.

**Version**

1.0

This is the firmware of the WFYD. It can control two motors and a servo motors and read their encoders. Also can read and convert analog measurements connected to the PSoC microcontroller.

# Chapter 2

# Data Structure Index

## 2.1 Data Structures

Here are the data structures with brief descriptions:

# Chapter 3

# File Index

## 3.1 File List

Here is a list of all documented files with brief descriptions:

# Chapter 4

# Data Structure Documentation

## 4.1 st_data Struct Reference

### Data Fields

- uint8 **buffer** [128]
- int16 **length**
- int16 **ind**
- uint8 **ready**

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

- **globals.h**

## 4.2 st_meas Struct Reference

### Data Fields

- int32 **pos** [NUM_OF_SENSORS]
- int16 **curr** [NUM_OF_MOTORS]
- int8 **rot** [NUM_OF_SENSORS]
- int16 **vel** [NUM_OF_SENSORS]
- int16 **acc** [NUM_OF_SENSORS]
- int16 **ir**
- int16 **servo**
- int16 **force**
- float **duty_cycle_f**

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

- **globals.h**

## 4.3 st_mem Struct Reference

### Data Fields

- uint8 **flag**
- uint8 **id**
- int32 **k_p**
- int32 **k_i**
- int32 **k_d**
- int16 **current_limit**
- uint8 **activ**
- uint8 **res** [NUM_OF_SENSORS]
- int32 **m_off** [NUM_OF_SENSORS]
- float **m_mult** [NUM_OF_SENSORS]
- uint8 **pos_lim_flag**
- int32 **pos_lim_inf** [NUM_OF_MOTORS]
- int32 **pos_lim_sup** [NUM_OF_MOTORS]
- uint16 **max_stiffness**
- uint8 **baud_rate**
- uint8 **watchdog_period**
- int32 **max_step_neg**
- int32 **max_step_pos**
- int32 **thr_max_force**
- int32 **thr_max_pressure**
- int32 **thr_min_pressure**
- int32 **thr_min_force**
- uint8 **flag_pulse**
- double **step_const**
- int32 **pulse_freq**
- uint16 **power_tension**

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

- **globals.h**

## 4.4 st_ref Struct Reference

### Data Fields

- int32 **pos** [NUM_OF_MOTORS]
- uint8 **onoff**

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

- **globals.h**

# Chapter 5

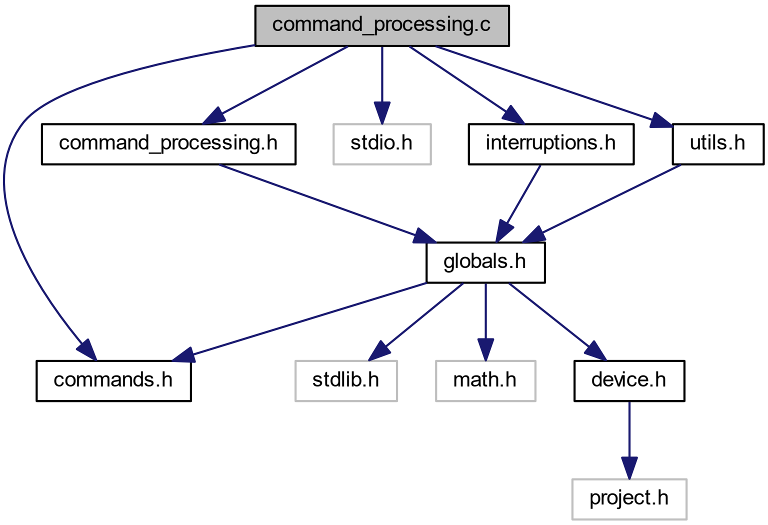
# File Documentation

## 5.1 command_processing.c File Reference

Command processing functions.

```
#include <command_processing.h>
#include <stdio.h>
#include <interruptions.h>
#include <utils.h>
#include "commands.h"
```

Include dependency graph for command_processing.c:



### Functions

- void **commProcess** ()

- void **infoGet** (uint16 info_type)
- void **setZeros** ()
- void **get_param_list** (uint16 index)
- void **infoPrepare** (unsigned char ∗info_string)
- void **commWrite_old_id** (uint8 ∗packet_data, uint16 packet_lenght, uint8 old_id)
- void **commWrite** (uint8 ∗packet_data, const uint16 packet_lenght, uint8 next)
- void **sendAcknowledgment** (const uint8 value)
- uint8 **memStore** (int displacement)
- void **memRecall** (void)
- uint8 **memRestore** (void)
- uint8 **memInit** (void)
- void **cmd_get_measurements** ()
- void **cmd_get_inputs** ()
- void **cmd_get_currents** ()
- void **cmd_get_curr_and_meas** ()
- void **cmd_set_inputs** ()
- void **cmd_get_velocities** ()
- void **cmd_activate** ()
- void **cmd_set_watchdog** ()
- void **cmd_get_activate** ()
- void **cmd_ping** ()
- void **cmd_store_params** ()
- void **cmd_set_baudrate** ()
- void **cmd_get_ir** ()
- void **cmd_get_servo** ()
- void **cmd_get_force** ()
- void **cmd_get_duty_cy_max** ()

## Variables

- reg8 ∗ **EEPROM_ADDR** = (reg8 ∗) CYDEV_EE_BASE

### 5.1.1 Detailed Description

Command processing functions.

**Date**

October 01, 2017

**Author**

*Centro "E.Piaggio"*

**Copyright**

### 5.1.2 Function Documentation

#### 5.1.2.1 cmd_get_measurements()

```
void cmd_get_measurements ( )
```

Bunch of functions used on request from UART communication

#### 5.1.2.2 memInit()

```
uint8 memInit (
             void  )
```

This function initialize memory when eeprom is compromised.

#### 5.1.2.3 memRecall()

```
void memRecall (
             void  )
```

This function loads user settings from the eeprom.

#### 5.1.2.4 memRestore()

```
uint8 memRestore (
             void  )
```

This function loads default settings from the eeprom.

#### 5.1.2.5 memStore()

```
uint8 memStore (
             int displacement )
```

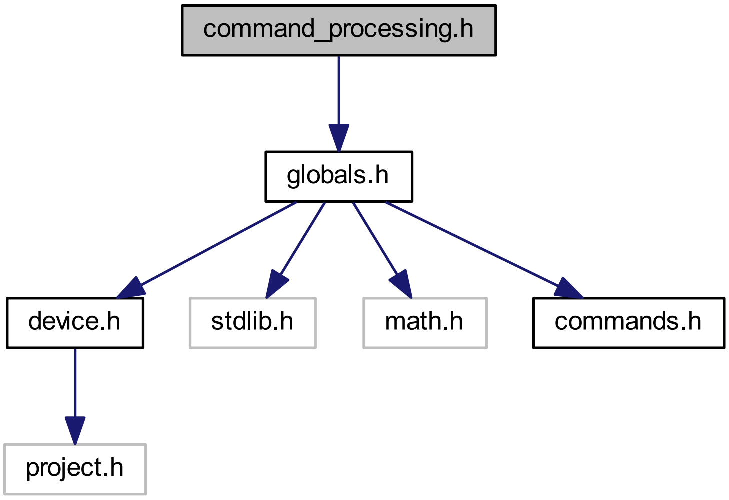
This function stores current memory settings on the eeprom with the specified displacement

## 5.2 command_processing.h File Reference

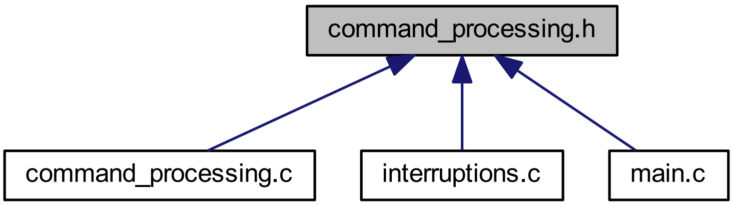
Command processing functions.

```
#include <globals.h>
```

Include dependency graph for command_processing.h:



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



### Functions

- void **setZeros** (void)
- void **get_param_list** (uint16 index)
- void **infoPrepare** (unsigned char ∗)
- void **infoGet** (uint16)
- void **commProcess** ()

- void **commWrite** (uint8 ∗, const uint16, uint8)
- void **commWrite_old_id** (uint8 ∗, const uint16, uint8)
- uint8 **memStore** (int)
- void **sendAcknowledgment** (const uint8)
- void **memRecall** (void)
- uint8 **memRestore** (void)
- uint8 **memInit** (void)
- void **cmd_get_measurements** ()
- void **cmd_get_inputs** ()
- void **cmd_get_currents** ()
- void **cmd_get_curr_and_meas** ()
- void **cmd_set_inputs** ()
- void **cmd_get_velocities** ()
- void **cmd_activate** ()
- void **cmd_set_watchdog** ()
- void **cmd_get_activate** ()
- void **cmd_ping** ()
- void **cmd_store_params** ()
- void **cmd_set_baudrate** ()
- void **cmd_get_ir** ()
- void **cmd_get_servo** ()
- void **cmd_get_force** ()
- void **cmd_get_duty_cy_max** ()

### 5.2.1 Detailed Description

Command processing functions.

**Date**

October 01, 2017

**Author**

*Centro "E.Piaggio"*

**Copyright**

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### 5.2.2 Function Documentation

#### 5.2.2.1 cmd_get_measurements()

```
void cmd_get_measurements ( )
```

Bunch of functions used on request from UART communication

#### 5.2.2.2 memInit()

```
uint8 memInit (
            void  )
```

This function initialize memory when eeprom is compromised.

#### 5.2.2.3 memRecall()

```
void memRecall (
            void  )
```

This function loads user settings from the eeprom.

#### 5.2.2.4 memRestore()

```
uint8 memRestore (
            void  )
```

This function loads default settings from the eeprom.

#### 5.2.2.5 memStore()

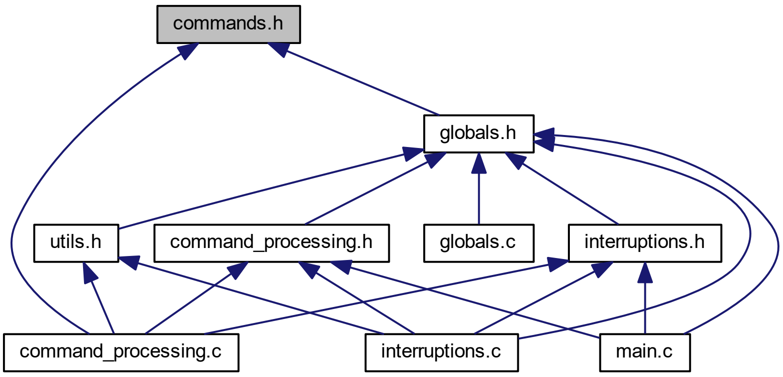
```
uint8 memStore (
            int displacement )
```

This function stores current memory settings on the eeprom with the specified displacement

## 5.3 commands.h File Reference

Definitions for commands, parameters and packages.

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



## Enumerations

### QB Move Commands

- enum **qbmove_command** {
  **CMD_PING** = 0, **CMD_SET_ZEROS** = 1, **CMD_STORE_PARAMS** = 3, **CMD_STORE_DEFAULT_PARAMS** = 4,
  **CMD_RESTORE_PARAMS** = 5, **CMD_GET_INFO** = 6, **CMD_SET_VALUE** = 7, **CMD_GET_VALUE** = 8,
  **CMD_BOOTLOADER** = 9, **CMD_INIT_MEM** = 10, **CMD_CALIBRATE** = 11, **CMD_GET_PARAM_LIST** = 12,
  **CMD_HAND_CALIBRATE** = 13, **CMD_ACTIVATE** = 128, **CMD_GET_ACTIVATE** = 129, **CMD_SET_INPUTS** = 130,
  **CMD_GET_INPUTS** = 131, **CMD_GET_MEASUREMENTS** = 132, **CMD_GET_CURRENTS** = 133, **CMD_GET_CURR_AND_MEAS** = 134,
  **CMD_SET_POS_STIFF** = 135, **CMD_GET_VELOCITIES** = 137, **CMD_GET_COUNTERS** = 138, **CMD_GET_ACCEL** = 139,
  **CMD_GET_CURR_DIFF** = 140, **CMD_SET_CURR_DIFF** = 141, **CMD_SET_CUFF_INPUTS** = 142, **CMD_SET_WATCHDOG** = 143,
  **CMD_SET_BAUDRATE** = 144, **CMD_EXT_DRIVE** = 145, **CMD_GET_JOYSTICK** = 146, **CMD_GET_IR** = 147,
  **CMD_SET_SERVO** = 148, **CMD_GET_SERVO** = 149, **CMD_GET_FORCE** = 150, **CMD_GET_DUTY_CY_MAX** = 151 }

## QB Move Parameters

- #define **PARAM_BYTE_SLOT** 50
- #define **PARAM_MENU_SLOT** 150
- #define **INFO_ALL** 0
- enum **qbmove_parameter** {
  **PARAM_ID** = 0, **PARAM_PID_CONTROL** = 1, **PARAM_STARTUP_ACTIVATION** = 2, **PARAM_INPUT_MODE** = 3,
  **PARAM_CONTROL_MODE** = 4, **PARAM_MEASUREMENT_OFFSET** = 5, **PARAM_MEASUREMENT_MULTIPLIER** = 6, **PARAM_POS_LIMIT_FLAG** = 7,
  **PARAM_POS_LIMIT** = 8, **PARAM_MAX_STEP_POS** = 9, **PARAM_MAX_STEP_NEG** = 10, **PARAM_POS_RESOLUTION** = 11,
  **PARAM_CURRENT_LIMIT** = 12, **PARAM_PID_CURR_CONTROL** = 18, **PARAM_CURR_PROP_GAIN** = 23, **PARAM_CURR_SAT** = 24,
  **PARAM_CURR_DEAD_ZONE** = 25, **PARAM_CUFF_ACTIVATION_FLAG** = 26, **PARAM_POWER_TENSION** = 27, **PARAM_PULSE_MODALITY** = 28,
  **PARAM_SUP_PRESSURE_BOUND** = 29, **PARAM_INF_PRESSURE_BOUND** = 30, **PARAM_PULSE_FREQ** = 31 }
- enum **qbmove_resolution** {
  **RESOLUTION_360** = 0, **RESOLUTION_720** = 1, **RESOLUTION_1440** = 2, **RESOLUTION_2880** = 3,
  **RESOLUTION_5760** = 4, **RESOLUTION_11520** = 5, **RESOLUTION_23040** = 6, **RESOLUTION_46080** = 7,
  **RESOLUTION_92160** = 8 }
- enum **qbmove_input_mode** { **INPUT_MODE_EXTERNAL** = 0, **INPUT_MODE_ENCODER3** = 1 }
- enum **qbmove_control_mode** { **CONTROL_ANGLE** = 0, **CONTROL_PWM** = 1, **CONTROL_CURRENT** = 2, **CURR_AND_POS_CONTROL** = 3 }
- enum **acknowledgment_values** { **ACK_ERROR** = 0, **ACK_OK** = 1 }
- enum **data_types** {
  **TYPE_FLAG** = 0, **TYPE_INT8** = 1, **TYPE_UINT8** = 2, **TYPE_INT16** = 3,
  **TYPE_UINT16** = 4, **TYPE_INT32** = 5, **TYPE_UINT32** = 6, **TYPE_FLOAT** = 7,
  **TYPE_DOUBLE** = 8 }

### 5.3.1 Detailed Description

Definitions for commands, parameters and packages.

**Date**

October 01, 2017

**Author**

*Centro "E.Piaggio"*

**Copyright**

### 5.3.2 Enumeration Type Documentation

#### 5.3.2.1 qbmove_command

```
enum qbmove_command
```

**Enumerator**

| | |
|---:|---|
| CMD_PING | Asks for a ping message. |
| CMD_SET_ZEROS | Command for setting the encoders zero position. |
| CMD_STORE_PARAMS | Stores all parameters in memory and loads them |
| CMD_STORE_DEFAULT_PARAMS | Store current parameters as factory parameters. |
| CMD_RESTORE_PARAMS | Restore default factory parameters. |
| CMD_GET_INFO | Asks for a string of information about. |
| CMD_SET_VALUE | Not Used. |
| CMD_GET_VALUE | Not Used. |
| CMD_BOOTLOADER | Sets the bootloader modality to update the firmware |
| CMD_INIT_MEM | Initialize the memory with the defalut values. |
| CMD_CALIBRATE | Not Used. |
| CMD_GET_PARAM_LIST | Command to get the parameters list or to set a defined value chosen by the use |
| CMD_HAND_CALIBRATE | Not Used. |
| CMD_ACTIVATE | Command for activating/deactivating the device |
| CMD_GET_ACTIVATE | Command for getting device activation state |
| CMD_SET_INPUTS | Command for setting reference inputs. |
| CMD_GET_INPUTS | Command for getting reference inputs. |
| CMD_GET_MEASUREMENTS | Command for asking device's position measurements |
| CMD_GET_CURRENTS | Command for asking device's current measurements |
| CMD_GET_CURR_AND_MEAS | Command for asking device's measurements and currents |
| CMD_SET_POS_STIFF | Not Used. |

**Enumerator**

| | |
|---|---|
| CMD_GET_VELOCITIES | Command for asking device's current velocity of motors and pulley |
| CMD_GET_COUNTERS | Command for asking device's counters (mostly used for debugging sent commands) |
| CMD_GET_ACCEL | Command for asking device's acceleration measurements |
| CMD_GET_CURR_DIFF | Not Used. |
| CMD_SET_CURR_DIFF | Not Used. |
| CMD_SET_CUFF_INPUTS | Not Used. |
| CMD_SET_WATCHDOG | Command for setting watchdog timer or disable it |
| CMD_SET_BAUDRATE | Command for setting baudrate of communication |
| CMD_EXT_DRIVE | Not Used. |
| CMD_GET_JOYSTICK | Not Used. |
| CMD_GET_IR | Command for asking ir readings (W-FYD) |
| CMD_SET_SERVO | Command for setting servo position (W-FYD) |
| CMD_GET_SERVO | Command for asking servo position (W-FYD) |
| CMD_GET_FORCE | Command for asking force measures (W-FYD) |
| CMD_GET_DUTY_CY_MAX | Command for setting the max dc (W-FYD) |

#### 5.3.2.2 qbmove_control_mode

```
enum qbmove_control_mode
```

**Enumerator**

| | |
|---|---|
| CONTROL_ANGLE | Classic position control. |
| CONTROL_PWM | Direct PWM value. |
| CONTROL_CURRENT | Current control (beta) |
| CURR_AND_POS_CONTROL | Position and current control. |

#### 5.3.2.3 qbmove_input_mode

```
enum qbmove_input_mode
```

**Enumerator**

| | |
|---|---|
| INPUT_MODE_EXTERNAL | References through external commands (default) |
| INPUT_MODE_ENCODER3 | Encoder 3 drives all inputs. |

#### 5.3.2.4 qbmove_parameter

```
enum qbmove_parameter
```

**Enumerator**

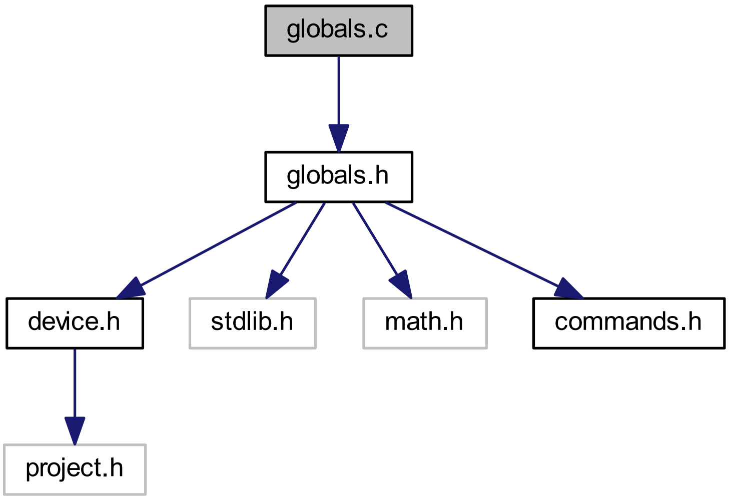
| | |
|---:|---|
| PARAM_ID | Device's ID number. |
| PARAM_PID_CONTROL | PID Control proportional constant. |
| PARAM_STARTUP_ACTIVATION | Start up activation byte. |
| PARAM_INPUT_MODE | Not Used. |
| PARAM_CONTROL_MODE | Not Used. |
| PARAM_MEASUREMENT_OFFSET | Adds a constant offset to the measurements |
| PARAM_MEASUREMENT_MULTIPLIER | Adds a multiplier to the measurements |
| PARAM_POS_LIMIT_FLAG | Enable/disable position limiting. |
| PARAM_POS_LIMIT | Position limit values \| int32 \| int32 \| int32 \| int32 \| \| INF_LIM_1 \| SUP_LIM_1 \| INF_LIM_2 \| SUP_LIM_2 \| |
| PARAM_MAX_STEP_POS | Used to slow down movements for positive values. |
| PARAM_MAX_STEP_NEG | Used to slow down movements for negative values. |
| PARAM_POS_RESOLUTION | Angle resolution for inputs and measurements. Used during communication. |
| PARAM_CURRENT_LIMIT | Limit for absorbed current. |
| PARAM_PID_CURR_CONTROL | Not Used. |
| PARAM_CURR_PROP_GAIN | Not Used. |
| PARAM_CURR_SAT | Not Used. |
| PARAM_CURR_DEAD_ZONE | Not Used. |
| PARAM_CUFF_ACTIVATION_FLAG | Not Used. |
| PARAM_POWER_TENSION | Device power tension. |
| PARAM_PULSE_MODALITY | Pulse modality byte (W-FYD) |
| PARAM_SUP_PRESSURE_BOUND | Systolic pressure value setting (W-FYD) |
| PARAM_INF_PRESSURE_BOUND | Diastolic pressure value setting (W-FYD) |
| PARAM_PULSE_FREQ | Pulse frequency setting (W-FYD) |

## 5.4 globals.c File Reference

Global variables.

```
#include <globals.h>
```

Include dependency graph for globals.c:



### Variables

- struct **st_ref** g_ref g_refNew **g_refOld**
- struct **st_meas** g_meas **g_measOld**
- struct **st_data** **g_rx**
- struct **st_mem** g_mem **c_mem**
- uint32 **timer_value**
- uint32 **timer_value0**
- int32 **dev_tension**
- uint8 **dev_pwm_limit**
- uint8 **calibration_flag**
- CYBIT **reset_last_value_flag**
- CYBIT **tension_valid**
- CYBIT **interrupt_flag**
- CYBIT **watchdog_flag**
- int16 **ADC_buf** [5]
- uint16 **pulse_counter**
- CYBIT **motor_pulse_started** = FALSE
- float **pulse_counter_float**

### 5.4.1 Detailed Description

Global variables.

**Date**

October 01, 2017

**Author**

*Centro "E.Piaggio"*

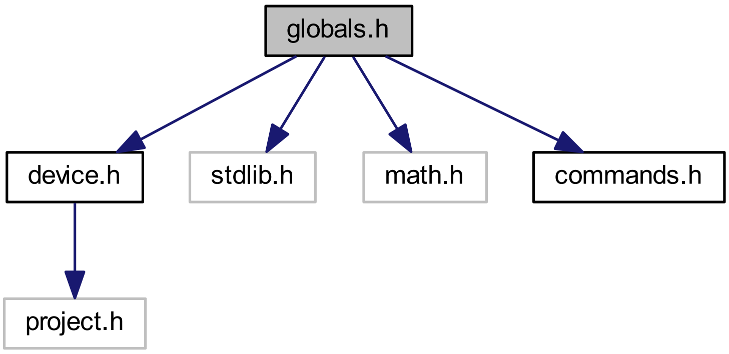
**Copyright**

## 5.5 globals.h File Reference

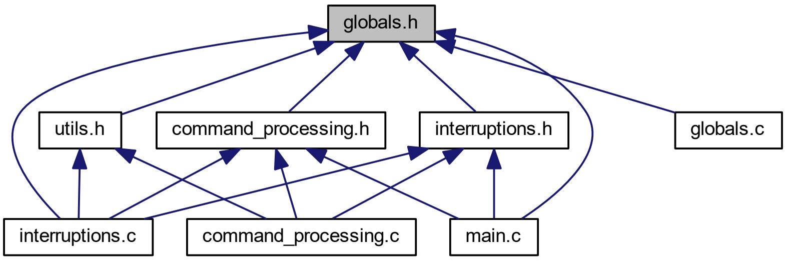
Global definitions and macros are set in this file.

```
#include <device.h>
#include "stdlib.h"
#include "math.h"
#include "commands.h"
```

Include dependency graph for globals.h:



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



## Data Structures

- struct **st_ref**
- struct **st_meas**
- struct **st_data**
- struct **st_mem**

## Macros

- #define **VERSION** "W-FYD MOD v6.1.0"
- #define **NUM_OF_MOTORS** 2
- #define **NUM_OF_SENSORS** 2
- #define **NUM_OF_ANALOG_INPUTS** 5
- #define **NUM_OF_PARAMS** 14
- #define **PWM_MAX_VALUE** 100
- #define **PWM_DEAD** 0
- #define **POS_INTEGRAL_SAT_LIMIT** 100000
- #define **CURR_INTEGRAL_SAT_LIMIT** 100000
- #define **CALIB_CURRENT** 1000
- #define **DEFAULT_CURRENT_LIMIT** 1500
- #define **CALIBRATION_DIV** 100
- #define **DIV_INIT_VALUE** 1
- #define **DMA_BYTES_PER_BURST** 2
- #define **DMA_REQUEST_PER_BURST** 1
- #define **DMA_SRC_BASE** (CYDEV_PERIPH_BASE)
- #define **DMA_DST_BASE** (CYDEV_SRAM_BASE)
- #define **WAIT_START** 0
- #define **WAIT_ID** 1
- #define **WAIT_LENGTH** 2
- #define **RECEIVE** 3
- #define **UNLOAD** 4
- #define **FALSE** 0
- #define **TRUE** 1
- #define **DEFAULT_EEPROM_DISPLACEMENT** 8
- #define **MAX_WATCHDOG_TIMER** 250
- #define **DEFAULT_MAX_FORCE_PULSE** 1900
- #define **DEFAULT_MIN_FORCE_PULSE** 1350
- #define **MAX_FORCE** 3520
- #define **MIN_FORCE** -1583

## Enumerations

- enum **calibration_status** {
  **STOP** = 0, **START** = 1, **CONTINUE_1** = 2, **CONTINUE_2** = 3,
  **PAUSE_1** = 4, **PAUSE_2** = 5 }

### Variables

- struct **st_ref** g_ref g_refNew **g_refOld**
- struct **st_meas** g_meas **g_measOld**
- struct **st_data** **g_rx**
- struct **st_mem** g_mem **c_mem**
- uint32 **timer_value**
- uint32 **timer_value0**
- int32 **dev_tension**
- uint8 **dev_pwm_limit**
- uint8 **calibration_flag**
- CYBIT **reset_last_value_flag**
- CYBIT **tension_valid**
- CYBIT **interrupt_flag**
- CYBIT **watchdog_flag**
- int16 **ADC_buf** [5]
- uint16 **pulse_counter**
- float **pulse_counter_float**
- CYBIT **motor_pulse_started**

### 5.5.1 Detailed Description

Global definitions and macros are set in this file.

**Date**

October 01, 2017

**Author**

*Centro "E.Piaggio"*

**Copyright**

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(C) 2017 Centro "E.Piaggio". All rights reserved.

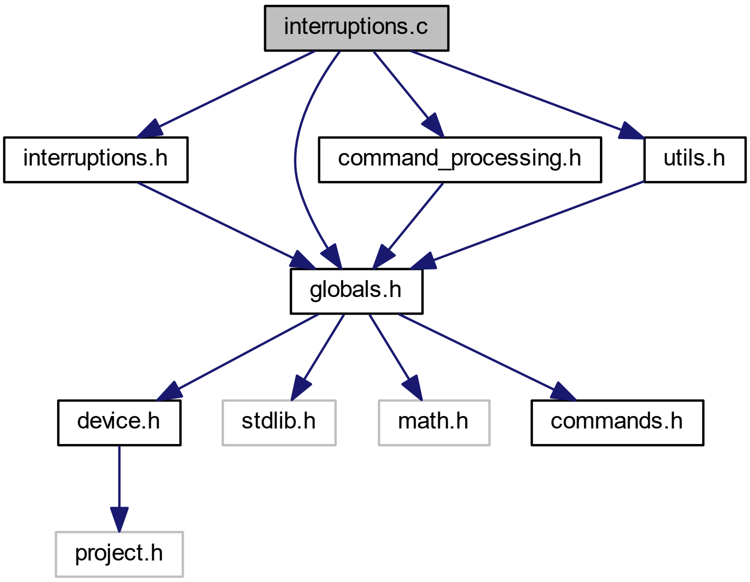
## 5.6 interruptions.c File Reference

Interruption functions are in this file.

```
#include <interruptions.h>
#include <command_processing.h>
#include "globals.h"
```

```
#include "utils.h"
```

Include dependency graph for interruptions.c:



## Functions

- **CY_ISR** (ISR_WATCHDOG_Handler)
- **CY_ISR** (ISR_RS485_RX_ExInterrupt)
- void **interrupt_manager** ()
- void **function_scheduler** (void)
- void **motor_control** (const uint8 idx)
- void **analog_read_end** ()
- void **encoder_reading** (const uint8 idx, const uint8 flag)
- void **calibration** ()
- void **pwm_limit_search** ()
- void **set_servo** (int16 duty)
- void **get_servo** ()

## Variables

- CYCODE uint8 **pwm_preload_values** [29]
- CYCODE uint8 **hitech_pwm_preload_values** [36]
- CYCODE uint8 **hitech_pwm_preload_values_6v** [32]

### 5.6.1 Detailed Description

Interruption functions are in this file.

**Date**

October 01, 2017

**Author**

*Centro "E.Piaggio"*

**Copyright**

### 5.6.2 Variable Documentation

#### 5.6.2.1 pwm_preload_values

```
CYCODE uint8 pwm_preload_values[29]
```

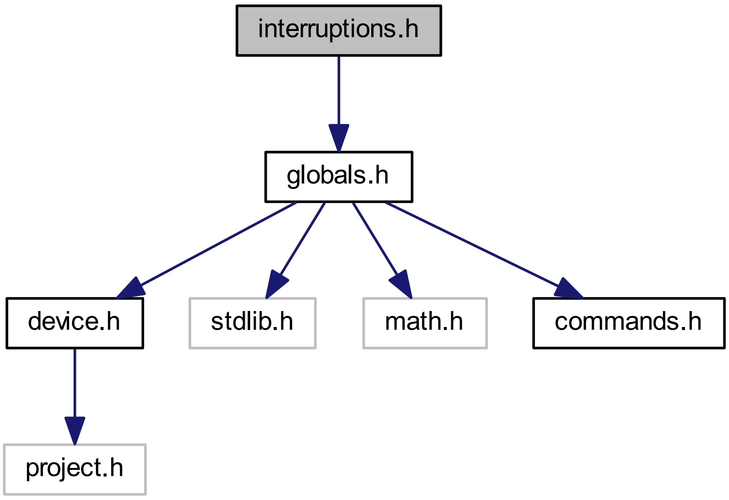
**Initial value:**

```
= {100,
                                             100,
                                             100,
                                              76,
                                              74,
                                              72,
                                              70,
                                              68,
                                              67,
                                              65,
                                              64,
                                              63,
                                              62,
                                              61,
                                              60,
                                              59,
                                              58,
                                              57,
                                              56,
                                              56,
                                              55,
                                              54,
                                              54,
                                              53,
                                              52,
                                              52,
                                              52,
                                              51,
                                              51}
```

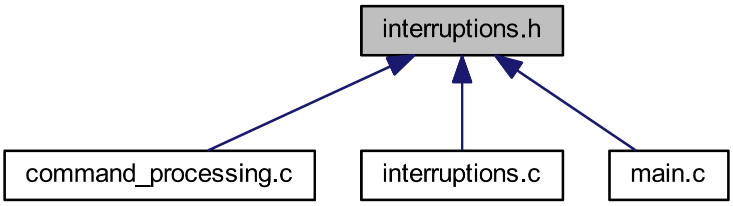
## 5.7 interruptions.h File Reference

Interruptions header file.

`#include <globals.h>`
Include dependency graph for interruptions.h:



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



### Functions

- **CY_ISR_PROTO** (ISR_RS485_RX_ExInterrupt)
- **CY_ISR_PROTO** (ISR_WATCHDOG_Handler)
- void **function_scheduler** (void)
- void **encoder_reading** (const uint8, const uint8)
- void **motor_control** (const uint8)

- void **analog_read_end** ()
- void **calibration** (void)
- void **pwm_limit_search** ()
- void **interrupt_manager** ()
- void **set_servo** (int16)
- void **get_servo** ()

### 5.7.1 Detailed Description

Interruptions header file.

**Date**

October 01, 2017

**Author**

*Centro "E.Piaggio"*

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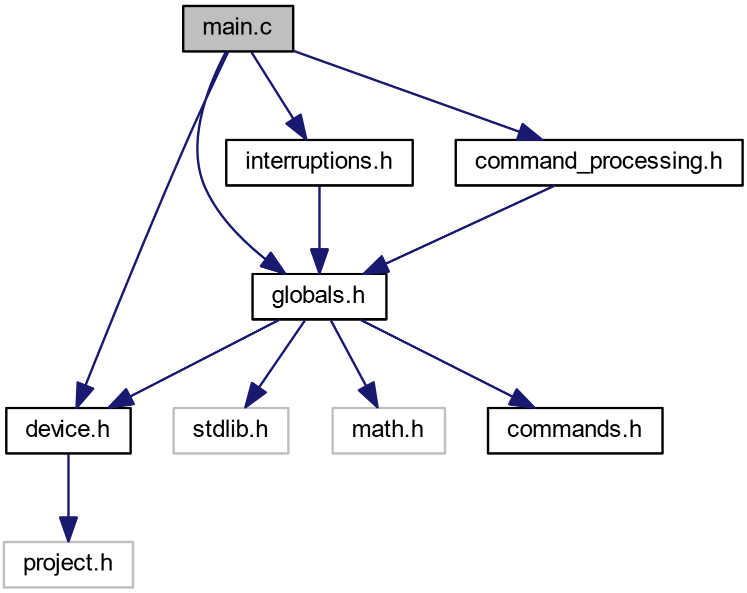
## 5.8 main.c File Reference

Firmware main file.

```
#include <device.h>
#include <globals.h>
#include <interruptions.h>
#include <command_processing.h>
```

Include dependency graph for main.c:



## Functions

- int **main** ()

### 5.8.1 Detailed Description

Firmware main file.

**Date**

October 01, 2017

**Author**

*Centro "E.Piaggio"*

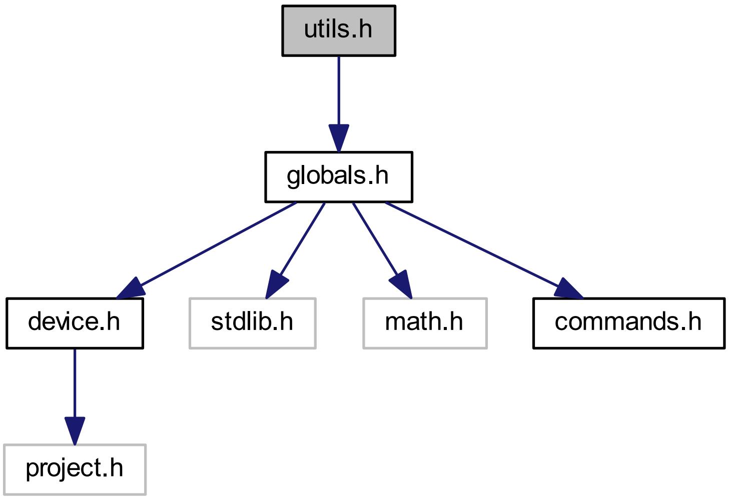
**Copyright**

## 5.9 utils.h File Reference

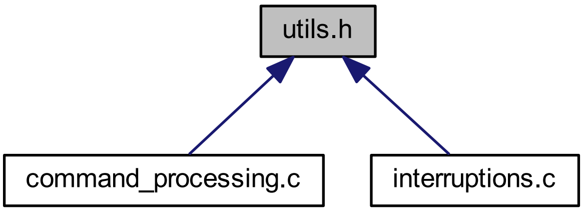
Definition of utility functions.

```
#include <globals.h>
```

Include dependency graph for utils.h:



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



### Macros

- #define **SIGN**(A) (((A) > 0) ? (1) : ((((A) < 0) ? (-1) : (0))))

## Functions

- int32 **filter_i1** (int32 value)
- int32 **filter_i2** (int32 value)
- int32 **filter_vel_1** (int32 value)
- int32 **filter_vel_2** (int32 value)
- int32 **filter_vel_3** (int32 value)
- uint8 **LCRChecksum** (uint8 ∗data_array, uint8 data_length)
- CYBIT **check_enc_data** (const uint32 ∗)

### 5.9.1 Detailed Description

Definition of utility functions.

Declaration of utility functions.

#### Date

October 01, 2017

#### Author

*Centro "E.Piaggio"*

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