



# **Application Note**

## **AN\_365**

# **FT9XX API Programmers Manual**

**Version 1.8**

**Issue Date: 29-08-2023**

This document describes the API for the v2.7.0 version of the FT9XX Hardware Library containing drivers for the device peripherals.

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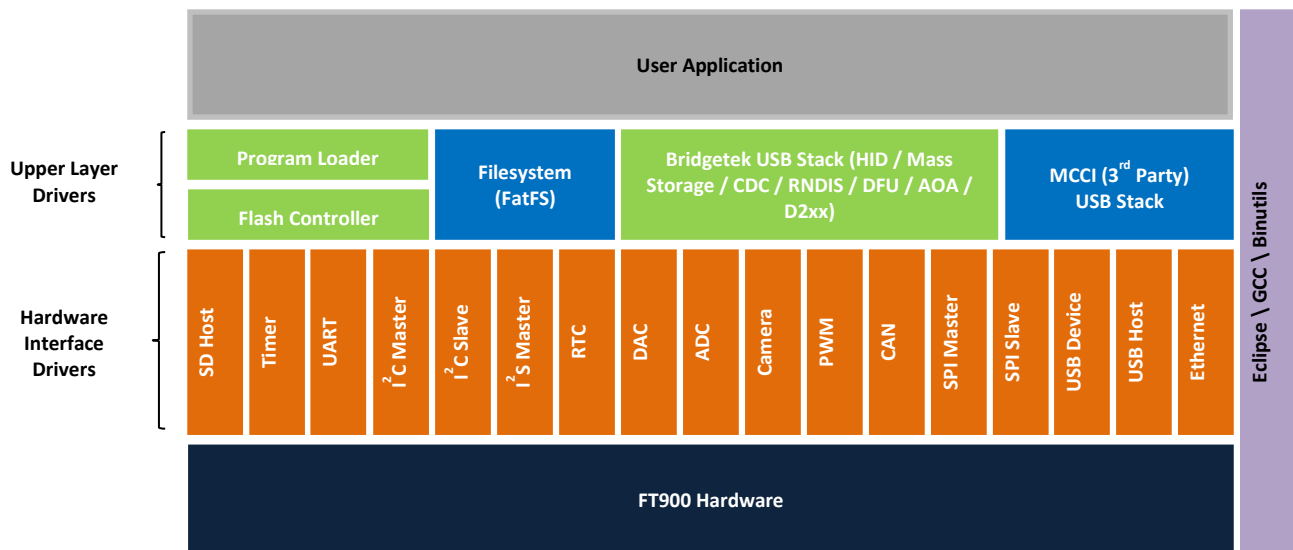
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## 1 Introduction

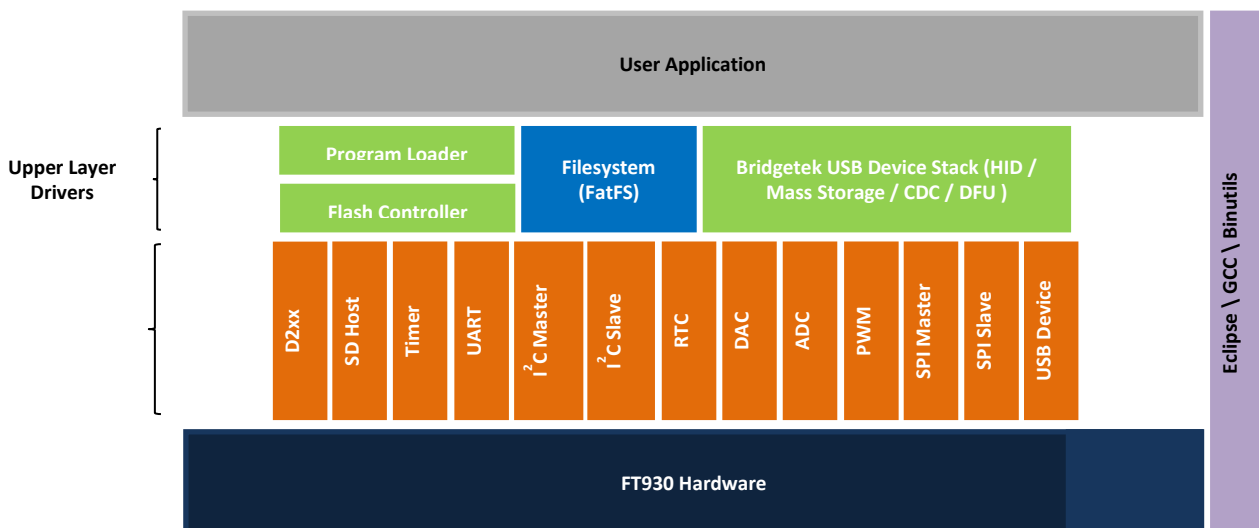
The FT9XX Peripheral Driver Library is a collection of “C” language-based functions that are intended to ease the development of applications running on the FT90X or FT93X Microcontroller.

This document describes the version released with the v2.7.0 FT9XX Toolchain.

Figure 1-1 and Figure 1.2 show the overall FT9XX Interface driver support. This document focuses on the Hardware Interface Driver layer. All drivers will be provided as source code for easy adaptation and modification.



**Figure 1.1 - FT90X Interface Driver Support**



**Figure 1.2 - FT93X Interface Driver Support**

This document describes the APIs for FT9XX Peripheral Driver Library.



## 2 Precompiled Libraries

The precompiled libraries provided with FT9XX Toolchain are shown in Table 1.

Library Name	Description
libft900.a	Peripheral driver library for FT90X Series of MCUs
libft900_d2xx_dev.a	D2XX library for FT90X Series of MCUs
libft900_d2xx_dev_rtos.a	D2XX library for FT90X Series of MCUs with support for FreeRTOS [Only required for FT90x]
libft930.a	Peripheral driver library for FT93X Series of MCUs
libft930_d2xx_dev.a	D2XX library for FT93X Series of MCUs. [Note that FT93X does not require a special library for FreeRTOS. This library can be used for both RTOS and non-RTOS use cases]
libftd2xx_host.a	D2XX Host library for FT90X Series of MCUs

**Table 1 - Precompiled Libraries released with FT9XX Toolchain**

All libraries are built in two modes – Debug and Release. Debug uses -Og optimization while Release uses -Os. The libraries are located in the toolchain installation folder at the relative path %FT9XX\_TOOLCHAIN%\hardware\lib\Debug and %FT9XX\_TOOLCHAIN%\hardware\lib\Release. The environment variable %FT9XX\_TOOLCHAIN% is set by the installer and informs Eclipse and other build tools where the toolchain collateral is located.

The precompiled driver libraries can be used as-is. However, if you want to change the way any of the source code in the libft900/930 library works, then copying the source code of a module to the Eclipse project you are working on allows you to ignore the version in the library and try out local changes.

For example, if you want to force the ethernet to use 10 Mbit/sec mode only, then copy the source code ethernet.c to the project and make the required changes to ETHERNET\_AUTO\_NEG\_ALLOW and ETHERNET\_MODE macro definitions in ethernet.c, in the project's workspace.

Compiling against the library will take the local version in preference to the library's version.

Source code can be found here (once IDE has been installed) at the relative path:  
%FT9XX\_TOOLCHAIN%\hardware\src

The sources for the D2xx libraries are not released with the toolchain. Please contact [support@brtchip.com](mailto:support@brtchip.com) if access to the source code is required.

This section discusses the API of the libft900/930 libraries. These are commonly referred to as the "Hardware Libraries".

### 2.1 Chip Management

The file **ft900\_sys.h** contains the definitions for the chip management functions in the libft900.a library and libft930.a

#### 2.1.1 API Cross Reference

It utilises the following library APIs:

**ft900\_delay.h** – Delay

Additional definitions are taken from:

**ft900\_registers.h** – FT90x and FT93x register definitions

## 2.1.2 Enumeration Type

### 2.1.2.1 *sys\_device\_t*

enum sys\_device\_t

FT90x Devices.

Enumerator	
sys_device_usb_host	USB Host
sys_device_usb_device	USB Device
sys_device_ethernet	Ethernet
sys_device_sd_card	SD Card
sys_device_can0	CAN0
sys_device_can1	CAN1
sys_device_i2c_master	I2C Master
sys_device_i2c_slave	I2C Slave
sys_device_spi_master	SPI Master
sys_device_spi_slave0	SPI Slave 0
sys_device_spi_slave1	SPI Slave 1
sys_device_uart0	UART0
sys_device_uart1	UART1
sys_device_pwm	PWM
sys_device_i2s	I2S
sys_device_camera	Camera
sys_device_timer_wdt	Timer and Watchdog Timer
sys_device_adc	Analogue to Digital Converter
sys_device_dac0	Digital to Analogue Converter 0
sys_device_dac1	Digital to Analogue Converter 1

FT93x Devices.

Enumerator	
sys_device_uart2	UART2
sys_device_uart3	UART3
sys_device_pwm	PWM
sys_device_uart1	UART1
sys_device_uart0	UART0
sys_device_spi_slave0	SPI Slave
sys_device_spi_master	SPI Master
sys_device_i2c_slave	I2C Slave
sys_device_spi_master	SPI Master
sys_device_i2c_master	I2C Master
sys_device_usb_device	USB Device

sys_device_timer_wdt	Timer and Watchdog Timer
sys_device_adc	ADC
sys_device_dac0	DAC0
sys_device_dac1	DAC1

### 2.1.2.2 *sys\_cpu\_divider\_t*

enum sys\_cpu\_divider\_t

CPU Clock divider.

Enumerator	
sys_cpu_divider_1	No clock divider (Default)
sys_cpu_divider_2	Divide Input Clock by 2
sys_cpu_divider_4	Divide Input Clock by 4
sys_cpu_divider_8	Divide Input Clock by 8
sys_cpu_divider_64	Divide Input Clock by 64
sys_cpu_divider_128	Divide Input Clock by 128
sys_cpu_divider_512	Divide Input Clock by 512

### 2.1.2.3 *sys\_pwm\_trigger\_t*

enum sys\_pwm\_trigger\_t

PWM External Trigger pin (only for FT90x).

Enumerator	
sys_pwm_trigger_none	None
sys_pwm_trigger_gpio18	GPIO18
sys_pwm_trigger_gpio26	GPIO26
sys_pwm_trigger_gpio35	GPIO35
sys_pwm_trigger_gpio40	GPIO40
sys_pwm_trigger_gpio46	GPIO46
sys_pwm_trigger_gpio52	GPIO52
sys_pwm_trigger_gpio58	GPIO58

## 2.1.3 Function Documentation

### 2.1.3.1 *sys\_enable*

int sys\_enable ( sys\_device\_t dev )

Enable a device on the FT9xx.

#### Parameters

**dev** - The device to enable.

#### Returns

On success a 0, otherwise -1.

### **2.1.3.2 sys\_disable**

```
int sys_disable ( sys_device_t dev )
```

Disable a device on the FT9xx.

#### **Parameters**

**dev** - The device to disable.

#### **Returns**

On success a 0, otherwise -1.

### **2.1.3.3 sys\_reset\_all**

```
void sys_reset_all ( void )
```

Reset all peripherals. sys\_cpu\_clock\_div

```
int sys_cpu_clock_div ( sys_cpu_divider_t div )
```

Enable a divider on the CPU.

#### **Parameters**

**div** - The divider to use.

#### **Returns**

On success a 0, otherwise -1.

### **2.1.3.4 sys\_get\_cpu\_clock**

```
uint32_t sys_get_cpu_clock ( void )
```

Get the current clock of the CPU.

#### **Returns**

The clock rate of the CPU in Hertz.

### **2.1.3.5 sys\_i2c\_swop**

```
int sys_i2c_swop ( uint8_t swop )
```

Swap the I2C Master and slave pins. The user must first configure the default master pins and assign the swapped I2C master to those pins. [This function is only available for FT90X]. For example:

```
gpio_function(44, pad_i2c1_scl);
```

```
gpio_pull(44, pad_pull_none);
```

```
gpio_function(45, pad_i2c1_sda);
```

```
gpio_pull(45, pad_pull_none);
```

#### **Parameters**

**swop** Enable or disable the swop feature.

#### **Returns**

On success a 0, otherwise -1.

### 2.1.3.6 *sys\_pwm\_ext\_trigger*

```
int sys_pwm_ext_trigger ( sys_pwm_trigger_t exttrigger )
```

Configure the External PWM trigger. [This function is only available for FT90X]

#### Parameters

**exttrigger** The selection of external trigger.

#### Returns

On success a 0, otherwise -1.

### 2.1.3.7 *sys\_check\_ft900\_revB*

Function macro that checks whether the revision of FT90X series is Revision B.

#### Returns

True if device is Revision B, and False otherwise.

## 2.2 Delay Functions

The file **ft900\_delay.h** contains the definitions for the delay functions in the libft900.a and libft930.a libraries.

### 2.2.1 API Cross Reference

Additional definitions are taken from:

**ft900\_registers.h** – FT90X and FT93X register definitions

### 2.2.2 Macro Definition Documentation

#### 2.2.2.1 *sleep*

```
#define sleep ( x ) delayms(x*1000)
```

POSIX standard second sleep call.

**Note:** This function consists of a tight loop counting CPU cycles to perform the delay. It is not recommended to use this function call at interrupt level or in FreeRTOS applications.

#### Parameters

**x** The number of milliseconds to sleep.

#### 2.2.2.2 *usleep*

```
#define usleep ( x ) delayus(x)
```

POSIX standard microsecond sleep call.

**Note:** This function consists of a tight loop counting CPU cycles to perform the delay. It is not recommended to use this function call at interrupt level or in FreeRTOS applications.

#### Parameters

**x** The number of microseconds to sleep.

## 2.3 Interrupt Management

The file **ft900\_interrupt.h** contains the definitions for the interrupt management functions in the libft900.a and libft930.a libraries.

### 2.3.1 API Cross Reference

Additional definitions are taken from:

**ft900\_registers.h** – FT90X and FT93X register definitions

### 2.3.2 Macro Definition Documentation

#### 2.3.2.1 *N\_INTERRUPTS*

```
#define N_INTERRUPTS (34)
```

The number of interrupts supported by the CPU, including watch dog interrupt vector which is not under the purview of interrupt controller.

### 2.3.3 Typedef Documentation

#### 2.3.3.1 *isrptr\_t*

```
typedef void(* isrptr_t) (void)
```

Interrupt handler function prototype.

### 2.3.4 Enumeration Type Documentation

#### 2.3.4.1 *interrupt\_t*

```
enum interrupt_t
```

FT90X Interrupt vectors:

Enumerator	
interrupt_0	Reserved
interrupt_usb_host	USB Host Interrupt
interrupt_usb_device	USB Device Interrupt
interrupt_ethernet	Ethernet Interrupt
interrupt_sd_card	SD Card Interrupt
interrupt_can0	CAN0 Interrupt
interrupt_can1	CAN1 Interrupt
interrupt_camera	Camera Interrupt
interrupt_spim	SPI Master Interrupt
interrupt_spis0	SPI Slave 0 Interrupt
interrupt_spis1	SPI Slave 1 Interrupt
interrupt_i2cm	I2C Master Interrupt
interrupt_i2cs	I2C Slave Interrupt
interrupt_uart0	UART0 Interrupt

interrupt_uart1	UART1 Interrupt
interrupt_i2s	I2S Interrupt
interrupt_pwm	PWM Interrupt
interrupt_timers	Timers Interrupt
interrupt_gpio	GPIO Interrupt
interrupt_rtc	RTC Interrupt
interrupt_adc	ADC Interrupt
interrupt_dac	DAC Interrupt
interrupt_slowclock	Slow clock timer interrupt
interrupt_wdg	First level watchdog timeout interrupt

FT93x Interrupt vectors:

Enumerator	
interrupt_0	Reserved
interrupt_1	Reserved
interrupt_usb_device	USB Device Interrupt
interrupt_3	Reserved
interrupt_sd_card	SD Card Interrupt
Interrupt_mailbox_source	Mailbox Source Interrupt
interrupt_mailbox_dest	Mailbox Destination Interrupt
interrupt_uart3	UART3 Interrupt
interrupt_spim	SPI Master Interrupt
interrupt_spis0	SPI Slave 0 Interrupt
interrupt_10	Reserved
interrupt_i2cm	I2C Master Interrupt
interrupt_i2cs	I2C Slave Interrupt
interrupt_uart0	UART0 Interrupt
interrupt_uart1	UART1 Interrupt
interrupt_uart2	UART2 Interrupt
interrupt_pwm	PWM Interrupt
interrupt_timers	Timers Interrupt
interrupt_gpio	GPIO Interrupt
interrupt_rtc	RTC Interrupt
interrupt_adc	ADC Interrupt
interrupt_dac	DAC Interrupt
interrupt_slowclock	Slow Clock Timer
interrupt_7channel_fifo	7 Channel FIFO interrupt
interrupt_wdg	First level watchdog timeout interrupt

### 2.3.5 Function Documentation

#### 2.3.5.1 *interrupt\_attach*

```
int8_t interrupt_attach ( interrupt_t interrupt,  
                        uint8_t    priority,  
                        isrptr_t    func  
                        )
```

Attach an interrupt.

##### Parameters

<b>interrupt</b>	The interrupt vector to attach to.
<b>priority</b>	The priority to give the interrupt.
<b>func</b>	The function to call when interrupted

##### Returns

0 on a success or -1 for a failure.

**Note:** Interrupt\_attach for a peripheral interrupt should be called prior to enabling that peripheral's interrupt. Doing otherwise could lead to a system hang.

#### 2.3.5.2 *interrupt\_detach*

```
int8_t interrupt_detach ( interrupt_t interrupt )
```

Detach an interrupt.

##### Parameters

<b>interrupt</b>	The interrupt vector to detach
------------------	--------------------------------

##### Returns

0 on a success or -1 for a failure.

#### 2.3.5.3 *interrupt\_disable\_globally*

```
int8_t interrupt_disable_globally ( void )
```

Disable all interrupts.

##### Returns

0 on a success or -1 for a failure.

#### 2.3.5.4 *interrupt\_disable\_nesting*

```
int8_t interrupt_disable_nesting ( void )
```

Disable nesting interrupts.

##### Returns

0 on a success or -1 for a failure.

#### 2.3.5.5 *interrupt\_enable\_globally*

```
int8_t interrupt_enable_globally ( void )
```



Enable interrupts to fire.

#### Returns

0 on a success or -1 for a failure.

#### 2.3.5.6 *interrupt\_enable\_nesting*

```
int8_t interrupt_enable_nesting ( uint8_t max )
```

Enable nesting interrupts.

#### Parameters

**max** The maximum number of levels to nest (max 16)

#### Returns

0 on a success or -1 for a failure.

## 2.4 General Purpose I/O and Pad Control

The file **ft900\_gpio.h** contains the definitions for the GPIO and Pad Control functions in the libft900.a and libft930.a libraries.

### 2.4.1 API Cross Reference

Additional definitions are taken from:

**ft900\_registers.h** – FT90X and FT93X register definitions

### 2.4.2 Function to Pad Mappings

Pins on FT90X and FT93X have multiple functions mapped onto them. The required function is selected by configuring the pin to its corresponding pad function. pad\_func\_X (X=0 to 3) selects the mapping. The available functions on a pin are shown in the following table.

FT90X Pin Mapping

Pin	pad_func_0	pad_func_1	pad_func_2	pad_func_3
VBUS_DISCH/GPIO0	GPIO0			
OC_N/GPIO1	GPIO1	OC_N		
PSW_N/GPIO2	GPIO2			
VBUS_DTC/GPIO3	GPIO3	VBUS_DTC		
ENET_LED0/GPIO4	GPIO4	ENET_LED0		
ENET_LED1/GPIO5	GPIO5	ENET_LED1		
ADC1/CAM_XCLK/GPIO6	GPIO6	CAM_XCLK		ADC1
ADC2/CAM_PCLK/GPIO7	GPIO7	CAM_PCLK		ADC2
ADC3/CAM_VD/GPIO8	GPIO8	CAM_VD		ADC3
ADC4/CAM_HD/GPIO9	GPIO9	CAM_HD		ADC4
ADC5/CAM_D7/GPIO10	GPIO10	CAM_D7		ADC5
ADC6/CAM_D6/GPIO11	GPIO11	CAM_D6		ADC6
ADC7/CAM_D5/GPIO12	GPIO12	CAM_D5		ADC7
DAC1/CAM_D4/GPIO13	GPIO13	CAM_D4		DAC1
DAC0/CAM_D3/GPIO14	GPIO14	CAM_D3		DAC0
CAN0_TXD/CAM_D2/GPIO15	GPIO15	CAM_D2	CAN0_TXD	
CAN0_RXD/CAM_D1/GPIO16	GPIO16	CAM_D1	CAN0_RXD	
CAN1_TXD/CAM_D0/GPIO17	GPIO17	CAM_D0	CAN1_TXD	

Pin	pad_func_0	pad_func_1	pad_func_2	pad_func_3
CAN1_RXD/GPIO18	GPIO18		CAN1_RXD	
SD_CLK/GPIO19	GPIO19	SD_CLK		
SD_CMD/GPIO20	GPIO20	SD_CMD		
SD_DATA3/GPIO21	GPIO21	SD_DATA3		
SD_DATA2/GPIO22	GPIO22	SD_DATA2		
SD_DATA1/GPIO23	GPIO23	SD_DATA1		
SD_DATA0/GPIO24	GPIO24	SD_DATA0		
SD_CD/GPIO25	GPIO25	SD_CD		
SD_WP/GPIO26	GPIO26	SD_WP		
SPIM_CLK/GPIO27	GPIO27	SPIM_CLK		
SPIM_SS0/GPIO28	GPIO28	SPIM_SS0		
SPIM_MOSI/GPIO29	GPIO29	SPIM_MOSI		
SPIM_MISO/GPIO30	GPIO30	SPIM_MISO		
SPIM_IO2/GPIO31	GPIO31	SPIM_IO2		
SPIM_IO3/GPIO32	GPIO32	SPIM_IO3		
SPIM_SS1/GPIO33	GPIO33	SPIM_SS1		
SPIM_SS2/GPIO34	GPIO34	SPIM_SS2		
SPIM_SS3/GPIO35	GPIO35	SPIM_SS3		
SPIS0_CLK/GPIO36	GPIO36	SPIS0_CLK		
SPIS0_SS/GPIO37	GPIO37	SPIS0_SS		
SPIS0_MOSI/GPIO38	GPIO38	SPIS0_MOSI		
SPIS0_MISO/GPIO39	GPIO39	SPIS0_MISO		
SPIS1_CLK/GPIO40	GPIO40	SPIS1_CLK		
SPIS1_SS/GPIO41	GPIO41	SPIS1_SS		
SPIS1_MOSI/GPIO42	GPIO42	SPIS1_MOSI		
SPIS1_MISO/GPIO43	GPIO43	SPIS1_MISO		
I2C0_SCL/GPIO44	GPIO44	I2C0_SCL		
I2C0_SDA/GPIO45	GPIO45	I2C0_SDA		
I2C1_SCL/GPIO46	GPIO46	I2C1_SCL		
I2C1_SDA/GPIO47	GPIO47	I2C1_SDA		
UART0_TXD/GPIO48	GPIO48			UART0_TXD
UART0_RXD/GPIO49	GPIO49			UART0_RXD
UART0_RTS/GPIO50	GPIO50			UART0_RTS
UART0_CTS/GPIO51	GPIO51			UART0_CTS
UART0_DTR/UART1_TXD/PWM4/GPIO52	GPIO52	PWM4	UART1_TXD	UART0_DTR
UART0_DSR/UART1_RXD/PWM5/GPIO53	GPIO53	PWM5	UART1_RXD	UART0_DSR
UART0_DCD/UART1_RTS/PWM6/GPIO54	GPIO54	PWM6	UART1_RTS	UART0_DCD
UART0_RI/UART1_CTS/PWM7/GPIO55	GPIO55	PWM7	UART1_CTS	UART0_RI
PWM0/GPIO56	GPIO56	PWM0		
PWM1/GPIO57	GPIO57	PWM1		
PWM2/GPIO58	GPIO58	PWM2		
PWM3/GPIO59	GPIO59	PWM3		
I2S_SDA0/GPIO60	GPIO60	I2S_SDA0		
I2S_SDAI/GPIO61	GPIO61	I2S_SDAI		
I2S_BCLK/GPIO62	GPIO62	I2S_BCLK	I2SS_BCLK	

Pin	pad_func_0	pad_func_1	pad_func_2	pad_func_3
I2S_LRCLK/GPIO63	GPIO63	I2S_LRCLK	I2SS_LRCLK	
I2S_MCLK/GPIO64	GPIO64	I2S_MCLK		
I2S_CLK22/GPIO65	GPIO65	I2S_CLK22		
I2S_CLK24/GPIO66	GPIO66	I2S_CLK24		

#### FT93x Pin Mapping

Pin	pad_func_0	pad_func_1	pad_func_2	pad_func_3
SD_CLK/SPIS_CLK/GPIO0	GPIO0	SPIS_CLK	SD_CLK	
SD_CMD/SPIS_MISO/GPIO1	GPIO1	SPIS_MISO	SD_CMD	
SD_CD/SPIS_MOSI/GPIO2	GPIO2	SPIS_MOSI	SD_CD	
SD_DATA0/SPIS_SS/GPIO3	GPIO3	SPIS_SS	SD_DATA0	
PWM0/SD_DATA1/PWM7/GPIO4	GPIO4	PWM7	SD_DATA1	PWM0
PWM6/SD_DATA2/PWM1/GPIO5	GPIO5	PWM1	SD_DATA2	PWM6
SD_DATA3/PWM5/GPIO6	GPIO6	PWM5	SD_DATA3	
SD_WP/PWM4/GPIO7	GPIO7	PWM4	SD_WP	
PWM3/GPIO8	GPIO8	PWM3		
PWM2/GPIO9	GPIO9	PWM2		
PWM1/GPIO10	GPIO10	PWM1		
PWM0/GPIO11	GPIO11	PWM0		
I2CS_SCL/I2CM_SCL/GPIO12	GPIO12	I2CM_SCL	I2CS_SCL	
I2CS_SDA/I2CM_SDA/GPIO13	GPIO13	I2CM_SDA	I2CS_SDA	
UART2_RXD/GPIO14	GPIO14	UART2_RXD		
UART2_TXD/GPIO15	GPIO15	UART2_TXD		
UART2_RTS/GPIO16	GPIO16	UART2_RTS		
UART2_CTS/GPIO17	GPIO17	UART2_CTS		
UART3_RXD/UART2_DTR/GPIO18	GPIO18	UART2_DTR	UART3_RXD	
UART3_TXD/UART2_DSR/GPIO19	GPIO19	UART2_DSR	UART3_TXD	
UART3_RTS/UART2_DCD/GPIO20	GPIO20	UART2_DCD	UART3_RTS	
UART3_CTS/UART2_RI/GPIO21	GPIO21	UART2_RI	UART3_CTS	
PWM3/UART0_RXD/GPIO22	GPIO22	UART0_RXD	PWM3	
PWM2/UART0_TXD/GPIO23	GPIO23	UART0_TXD	PWM2	
PWM1/UART0_RTS/GPIO24	GPIO24	UART0_RTS	PWM1	
PWM0/UART0_CTS/GPIO25	GPIO25	UART0_CTS	PWM0	
UART1_RXD/UART0_DTR/GPIO26	GPIO26	UART0_DTR	UART1_RXD	
UART1_TXD/UART0_DSR/GPIO27	GPIO27	UART0_DSR	UART1_TXD	
UART1_RTS/UART0_DCD/GPIO28	GPIO28	UART0_DCD	UART1_RTS	
SPIM_SS0/UART1_CTS/UART0_RI/GPIO29	GPIO29	UART0_RI	UART1_CTS	SPIM_SS0
SPIM_SS0/GPIO30	GPIO30	SPIM_SS0		
SPIM_SS1/GPIO31	GPIO31	SPIM_SS1		
SPIM_SS2/GPIO32	GPIO32	SPIM_SS2		
SPIM_SS3/GPIO33	GPIO33	SPIM_SS3		
SPIS_CLK/SPIM_CLK/GPIO34	GPIO34	SPIM_CLK	SPIS_CLK	
SPIS_MISO/SPIM_MISO/GPIO35	GPIO35	SPIM_MISO	SPIS_MISO	
SPIS_MOSI/SPIM_MOSI/GPIO36	GPIO36	SPIM_MOSI	SPIS_MOSI	
SPIS_SS/SPIM_IO2/GPIO37	GPIO37	SPIM_IO2	SPIS_SS	
RTC_REF/SPIM_IO3/GPIO38	GPIO38	SPIM_IO3	RTC_REF	

Pin	pad_func_0	pad_func_1	pad_func_2	pad_func_3
SPIS0_MISO/GPIO39	GPIO39	SPIS0_MISO		
VBUS_DTC/GPIO39	GPIO40	VBUS_DTC		

### 2.4.3 Enumeration Type Documentation

#### 2.4.3.1 *gpio\_int\_edge\_t*

enum gpio\_int\_edge\_t

GPIO Interrupt control.

Enumerator	
gpio_int_edge_falling	Interrupt on a falling edge
gpio_int_edge_raising	Interrupt on a raising edge

#### 2.4.3.2 *pad\_dir\_t*

enum pad\_dir\_t

Pad direction control.

Enumerator	
pad_dir_input	Input
pad_dir_output	Output
pad_dir_open_drain	Open Drain

#### 2.4.3.3 *pad\_drive\_t*

enum pad\_drive\_t

Pad current drive control.

Enumerator	
pad_drive_4mA	4mA maximum current
pad_drive_8mA	8mA maximum current
pad_drive_12mA	12mA maximum current
pad_drive_16mA	16mA maximum current

#### 2.4.3.4 *pad\_func\_t*

enum pad\_func\_t

Pad function control for FT90X

Enumerator	
pad_func_0	Pad function 0
pad_func_1	Pad function 1
pad_func_2	Pad function 2
pad_func_3	Pad function 3
pad_gpio0	VBUS_DISCH/GPIO0 Pad function 0

pad_gpio1	OC_N/GPIO1 Pad function 0
pad_gpio2	PSW_N/GPIO2 Pad function 0
pad_gpio3	VBUS_DTC/GPIO3 Pad function 0
pad_gpio4	ENET_LED0/GPIO4 Pad function 0
pad_gpio5	ENET_LED1/GPIO5 Pad function 0
pad_gpio6	ADC1/CAM_XCLK/GPIO6 Pad function 0
pad_gpio7	ADC2/CAM_PCLK/GPIO7 Pad function 0
pad_gpio8	ADC3/CAM_VD/GPIO8 Pad function 0
pad_gpio9	ADC4/CAM_HD/GPIO9 Pad function 0
pad_gpio10	ADC5/CAM_D7/GPIO10 Pad function 0
pad_gpio11	ADC6/CAM_D6/GPIO11 Pad function 0
pad_gpio12	ADC7/CAM_D5/GPIO12 Pad function 0
pad_gpio13	DAC1/CAM_D4/GPIO13 Pad function 0
pad_gpio14	DAC0/CAM_D3/GPIO14 Pad function 0
pad_gpio15	CAN0_TXD/CAM_D2/GPIO15 Pad function 0
pad_gpio16	CAN0_RXD/CAM_D1/GPIO16 Pad function 0
pad_gpio17	CAN1_TXD/CAM_D0/GPIO17 Pad function 0
pad_gpio18	CAN1_RXD/GPIO18 Pad function 0
pad_gpio19	SD_CLK/GPIO19 Pad function 0
pad_gpio20	SD_CMD/GPIO20 Pad function 0
pad_gpio21	SD_DATA3/GPIO21 Pad function 0
pad_gpio22	SD_DATA2/GPIO22 Pad function 0
pad_gpio23	SD_DATA1/GPIO23 Pad function 0
pad_gpio24	SD_DATA0/GPIO24 Pad function 0
pad_gpio25	SD_CD/GPIO25 Pad function 0
pad_gpio26	SD_WP/GPIO26 Pad function 0
pad_gpio27	SPIM_CLK/GPIO27 Pad function 0
pad_gpio28	SPIM_SS0/GPIO28 Pad function 0
pad_gpio29	SPIM_MOSI/GPIO29 Pad function 0
pad_gpio30	SPIM_MISO/GPIO30 Pad function 0
pad_gpio31	SPIM_IO2/GPIO31 Pad function 0
pad_gpio32	SPIM_IO3/GPIO32 Pad function 0
pad_gpio33	SPIM_SS1/GPIO33 Pad function 0
pad_gpio34	SPIM_SS2/GPIO34 Pad function 0
pad_gpio35	SPIM_SS3/GPIO35 Pad function 0
pad_gpio36	SPIS0_CLK/GPIO36 Pad function 0
pad_gpio37	SPIS0_SS/GPIO37 Pad function 0
pad_gpio38	SPIS0_MOSI/GPIO38 Pad function 0
pad_gpio39	SPIS0_MISO/GPIO39 Pad function 0

pad_gpio40	SPIS1_CLK/GPIO40 Pad function 0
pad_gpio41	SPIS1_SS/GPIO41 Pad function 0
pad_gpio42	SPIS1_MOSI/GPIO42 Pad function 0
pad_gpio43	SPIS1_MISO/GPIO43 Pad function 0
pad_gpio44	I2C0_SCL/GPIO44 Pad function 0
pad_gpio45	I2C0_SDA/GPIO45 Pad function 0
pad_gpio46	I2C1_SCL/GPIO46 Pad function 0
pad_gpio47	I2C1_SDA/GPIO47 Pad function 0
pad_gpio48	UART0_TXD/GPIO48 Pad function 0
pad_gpio49	UART0_RXD/GPIO49 Pad function 0
pad_gpio50	UART0_RTS/GPIO50 Pad function 0
pad_gpio51	UART0_CTS/GPIO51 Pad function 0
pad_gpio52	UART0_DTR/UART1_TXD/PWM4/GPIO52 Pad function 0
pad_gpio53	UART0_DSR/UART1_RXD/PWM5/GPIO53 Pad function 0
pad_gpio54	UART0_DCD/UART1_RTS/PWM6/GPIO54 Pad function 0
pad_gpio55	UART0_RI/UART1_CTS/PWM7/GPIO55 Pad function 0
pad_gpio56	PWM0/GPIO56 Pad function 0
pad_gpio57	PWM1/GPIO57 Pad function 0
pad_gpio58	PWM2/GPIO58 Pad function 0
pad_gpio59	PWM3/GPIO59 Pad function 0
pad_gpio60	I2S_SDAO/GPIO60 Pad function 0
pad_gpio61	I2S_SDAI/GPIO61 Pad function 0
pad_gpio62	I2S_BCLK/GPIO62 Pad function 0
pad_gpio63	I2S_LRCLK/GPIO63 Pad function 0
pad_gpio64	I2S_MCLK/GPIO64 Pad function 0
pad_gpio65	I2S_CLK22/GPIO65 Pad function 0
pad_gpio66	I2S_CLK24/GPIO66 Pad function 0
pad_oc_n	OC_N/GPIO1 Pad function 1
pad_vbus_dtc	VBUS_DTC/GPIO3 Pad function 1
pad_enet_led0	ENET_LED0/GPIO4 Pad function 1
pad_enet_led1	ENET_LED1/GPIO5 Pad function 1
pad_cam_xclk	ADC1/CAM_XCLK/GPIO6 Pad function 1
pad_cam_pclk	ADC2/CAM_PCLK/GPIO7 Pad function 1
pad_cam_vd	ADC3/CAM_VD/GPIO8 Pad function 1
pad_cam_hd	ADC4/CAM_HD/GPIO9 Pad function 1
pad_cam_d7	ADC5/CAM_D7/GPIO10 Pad function 1
pad_cam_d6	ADC6/CAM_D6/GPIO11 Pad function 1
pad_cam_d5	ADC7/CAM_D5/GPIO12 Pad function 1
pad_cam_d4	DAC1/CAM_D4/GPIO13 Pad function 1

pad_cam_d3	DAC0/CAM_D3/GPIO14 Pad function 1
pad_cam_d2	CAN0_TXD/CAM_D2/GPIO15 Pad function 1
pad_cam_d1	CAN0_RXD/CAM_D1/GPIO16 Pad function 1
pad_cam_d0	CAN1_TXD/CAM_D0/GPIO17 Pad function 1
pad_sd_clk	SD_CLK/GPIO19 Pad function 1
pad_sd_cmd	SD_CMD/GPIO20 Pad function 1
pad_sd_data3	SD_DATA3/GPIO21 Pad function 1
pad_sd_data2	SD_DATA2/GPIO22 Pad function 1
pad_sd_data1	SD_DATA1/GPIO23 Pad function 1
pad_sd_data0	SD_DATA0/GPIO24 Pad function 1
pad_sd_cd	SD_CD/GPIO25 Pad function 1
pad_sd_wp	SD_WP/GPIO26 Pad function 1
pad_spim_sck	SPIM_CLK/GPIO27 Pad function 1
pad_spim_ss0	SPIM_SS0/GPIO28 Pad function 1
pad_spim_mosi	SPIM_MOSI/GPIO29 Pad function 1
pad_spim_miso	SPIM_MISO/GPIO30 Pad function 1
pad_spim_io2	SPIM_IO2/GPIO31 Pad function 1
pad_spim_io3	SPIM_IO3/GPIO32 Pad function 1
pad_spim_ss1	SPIM_SS1/GPIO33 Pad function 1
pad_spim_ss2	SPIM_SS2/GPIO34 Pad function 1
pad_spim_ss3	SPIM_SS3/GPIO35 Pad function 1
pad_spis0_clk	SPIS0_CLK/GPIO36 Pad function 1
pad_spis0_ss	SPIS0_SS/GPIO37 Pad function 1
pad_spis0_mosi	SPIS0_MOSI/GPIO38 Pad function 1
pad_spis0_miso	SPIS0_MISO/GPIO39 Pad function 1
pad_spis1_clk	SPIS1_CLK/GPIO40 Pad function 1
pad_spis1_ss	SPIS1_SS/GPIO41 Pad function 1
pad_spis1_mosi	SPIS1_MOSI/GPIO42 Pad function 1
pad_spis1_miso	SPIS1_MISO/GPIO43 Pad function 1
pad_i2c0_scl	I2C0_SCL/GPIO44 Pad function 1
pad_i2c0_sda	I2C0_SDA/GPIO45 Pad function 1
pad_i2c1_scl	I2C1_SCL/GPIO46 Pad function 1
pad_i2c1_sda	I2C1_SDA/GPIO47 Pad function 1
pad_pwm4	UART0_DTR/UART1_TXD/PWM4/GPIO52 Pad function 1
pad_pwm5	UART0_DSR/UART1_RXD/PWM5/GPIO53 Pad function 1
pad_pwm6	UART0_DCD/UART1_RTS/PWM6/GPIO54 Pad function 1
pad_pwm7	UART0_RI/UART1_CTS/PWM7/GPIO55 Pad function 1
pad_pwm0	PWM0/GPIO56 Pad function 1
pad_pwm1	PWM1/GPIO57 Pad function 1

pad_pwm2	PWM2/GPIO58 Pad function 1
pad_pwm3	PWM3/GPIO59 Pad function 1
pad_i2s_sdao	I2S_SDAO/GPIO60 Pad function 1
pad_i2s_sdai	I2S_SDAI/GPIO61 Pad function 1
pad_i2s_bclk	I2S_BCLK/GPIO62 Pad function 1
pad_i2s_lrclk	I2S_LRCLK/GPIO63 Pad function 1
pad_i2s_mclk	I2S_MCLK/GPIO64 Pad function 1
pad_i2s_clk22	I2S_CLK22/GPIO65 Pad function 1
pad_i2s_clk24	I2S_CLK24/GPIO66 Pad function 1
pad_can0_txd	CAN0_TXD/CAM_D2/GPIO15 Pad function 2
pad_can0_rxd	CAN0_RXD/CAM_D1/GPIO16 Pad function 2
pad_can1_txd	CAN1_TXD/CAM_D0/GPIO17 Pad function 2
pad_can1_rxd	CAN1_RXD/GPIO18 Pad function 2
pad_uart1_txd	UART0_DTR/UART1_TXD/PWM4/GPIO52 Pad function 2
pad_uart1_rxd	UART0_DSR/UART1_RXD/PWM5/GPIO53 Pad function 2
pad_uart1_rts	UART0_DCD/UART1_RTS/PWM6/GPIO54 Pad function 2
pad_uart1_cts	UART0_RI/UART1_CTS/PWM7/GPIO55 Pad function 2
pad_i2ss_bclk	I2S_BCLK/GPIO62 Pad function 2
pad_i2ss_lrclk	I2S_LRCLK/GPIO63 Pad function 2
pad_adc1	ADC1/CAM_XCLK/GPIO6 Pad function 3
pad_adc2	ADC2/CAM_PCLK/GPIO7 Pad function 3
pad_adc3	ADC3/CAM_VD/GPIO8 Pad function 3
pad_adc4	ADC4/CAM_HD/GPIO9 Pad function 3
pad_adc5	ADC5/CAM_D7/GPIO10 Pad function 3
pad_adc6	ADC6/CAM_D6/GPIO11 Pad function 3
pad_adc7	ADC7/CAM_D5/GPIO12 Pad function 3
pad_dac1	DAC1/CAM_D4/GPIO13 Pad function 3
pad_dac0	DAC0/CAM_D3/GPIO14 Pad function 3
pad_uart0_txd	UART0_TXD/GPIO48 Pad function 3
pad_uart0_rxd	UART0_RXD/GPIO49 Pad function 3
pad_uart0_rts	UART0_RTS/GPIO50 Pad function 3
pad_uart0_cts	UART0_CTS/GPIO51 Pad function 3
pad_uart0_dtr	UART0_DTR/UART1_TXD/PWM4/GPIO52 Pad function 3
pad_uart0_dsr	UART0_DSR/UART1_RXD/PWM5/GPIO53 Pad function 3
pad_uart0_dcd	UART0_DCD/UART1_RTS/PWM6/GPIO54 Pad function 3
pad_uart0_ri	UART0_RI/UART1_CTS/PWM7/GPIO55 Pad function 3



Pad function control for FT93x

Enumerator	
pad_func_0	Pad function 0
pad_func_1	Pad function 1
pad_func_2	Pad function 2
pad_func_3	Pad function 3
pad_gpio0	SD_CLK/SPIS_CLK/GPIO0 Pad function 0
pad_gpio1	SD_CMD/SPIS_MISO/GPIO1 Pad function 0
pad_gpio2	SD_CD/SPIS_MOSI/GPIO2 Pad function 0
pad_gpio3	SD_DATA0/SPIS_SS/GPIO3 Pad function 0
pad_gpio4	PWM0/SD_DATA1/PWM7/GPIO4 Pad function 0
pad_gpio5	PWM6/SD_DATA2/PWM1/GPIO5 Pad function 0
pad_gpio6	SD_DATA3/PWM5/GPIO6 Pad function 0
pad_gpio7	SD_WP/PWM4/GPIO7 Pad function 0
pad_gpio8	PWM3/GPIO8 Pad function 0
pad_gpio9	PWM2/GPIO9 Pad function 0
pad_gpio10	PWM1/GPIO10 Pad function 0
pad_gpio11	PWM0/GPIO11 Pad function 0
pad_gpio12	I2CS_SCL/I2CM_SCL/GPIO12 Pad function 0
pad_gpio13	I2CS_SDA/I2CM_SDA/GPIO13 Pad function 0
pad_gpio14	UART2_RXD/GPIO14 Pad function 0
pad_gpio15	UART2_TXD/GPIO15 Pad function 0
pad_gpio16	UART2_RTS/GPIO16 Pad function 0
pad_gpio17	UART2_CTS/GPIO17 Pad function 0
pad_gpio18	UART3_RXD/UART2_DTR/GPIO18 Pad function 0
pad_gpio19	UART3_TXD/UART2_DSR/GPIO19 Pad function 0
pad_gpio20	UART3_RTS/UART2_DCD/GPIO20 Pad function 0
pad_gpio21	UART3_CTS/UART2_RI/GPIO21 Pad function 0
pad_gpio22	PWM3/UART0_RXD/GPIO22 Pad function 0
pad_gpio23	PWM2/UART0_TXD/GPIO23 Pad function 0
pad_gpio24	PWM1/UART0_RTS/GPIO24 Pad function 0
pad_gpio25	PWM0/UART0_CTS/GPIO25 Pad function 0
pad_gpio26	UART1_RXD/UART0_DTR/GPIO26 Pad function 0
pad_gpio27	UART1_TXD/UART0_DSR/GPIO27 Pad function 0
pad_gpio28	UART1_RTS/UART0_DCD/GPIO28 Pad function 0
pad_gpio29	SPIM_SS0/UART1_CTS/UART0_RI/GPIO29 Pad function 0
pad_gpio30	SPIM_SS0/GPIO30 Pad function 0
pad_gpio31	SPIM_SS1/GPIO31 Pad function 0
pad_gpio32	SPIM_SS2/GPIO32 Pad function 0

pad_gpio33	SPIM_SS3/GPIO33 Pad function 0
pad_gpio34	SPIS_CLK/SPIM_CLK/GPIO34 Pad function 0
pad_gpio35	SPIS_MISO/SPIM_MISO/GPIO35 Pad function 0
pad_gpio36	SPIS_MOSI/SPIM_MOSI/GPIO36 Pad function 0
pad_gpio37	SPIS_SS/SPIM_IO2/GPIO37 Pad function 0
pad_gpio38	RTC_REF/SPIM_IO3/GPIO38 Pad function 0
pad_gpio39	VBUS_DTC/GPIO39 Pad function 0
pad0_spis0_clk	SD_CLK/SPIS_CLK/GPIO0 Pad function 1
pad1_spis0_miso	SD_CMD/SPIS_MISO/GPIO1 Pad function 1
pad2_spis0_mosi	SD_CD/SPIS_MOSI/GPIO2 Pad function 1
pad3_spis0_ss	SD_DATA0/SPIS_SS/GPIO3 Pad function 1
pad_pwm7	PWM0/SD_DATA1/PWM7/GPIO4 Pad function 1
pad_pwm6	PWM6/SD_DATA2/PWM1/GPIO5 Pad function 1
pad_pwm5	SD_DATA3/PWM5/GPIO6 Pad function 1
pad_pwm4	SD_WP/PWM4/GPIO7 Pad function 1
pad8_pwm3	PWM3/GPIO8 Pad function 1
pad9_pwm2	PWM2/GPIO9 Pad function 1
pad11_pwm0	PWM0/GPIO11 Pad function 1
pad10_pwm1	PWM1/GPIO10 Pad function 1
pad_i2cm_scl	I2CS_SCL/I2CM_SCL/GPIO12 Pad function 1
pad_i2cm_sda	I2CS_SDA/I2CM_SDA/GPIO13 Pad function 1
pad_uart2_rxd	UART2_RXD/GPIO14 Pad function 1
pad_uart2_txd	UART2_TXD/GPIO15 Pad function 1
pad_uart2_rts	UART2_RTS/GPIO16 Pad function 1
pad_uart2_cts	UART2_CTS/GPIO17 Pad function 1
pad_uart2_dtr	UART3_RXD/UART2_DTR/GPIO18 Pad function 1
pad_uart2_dsr	UART3_TXD/UART2_DSR/GPIO19 Pad function 1
pad_uart2_dcd	UART3_RTS/UART2_DCD/GPIO20 Pad function 1
pad_uart0_rxd	UART3_CTS/UART2_RI/GPIO21 Pad function 1
pad_uart0_txd	PWM3/UART0_RXD/GPIO22 Pad function 1
pad_uart0_rts	PWM2/UART0_TXD/GPIO23 Pad function 1
pad_uart0_cts	PWM1/UART0_RTS/GPIO24 Pad function 1
pad_uart0_dtr	PWM0/UART0_CTS/GPIO25 Pad function 1
pad_uart0_dsr	UART1_RXD/UART0_DTR/GPIO26 Pad function 1
pad_uart0_dcd	UART1_TXD/UART0_DSR/GPIO27 Pad function 1
pad_uart0_ri	UART1_RTS/UART0_DCD/GPIO28 Pad function 1
pad30_spim_ss0	SPIM_SS0/UART1_CTS/UART0_RI/GPIO29 Pad function 1
pad_spim_ss1	SPIM_SS1/GPIO31 Pad function 1
pad_spim_ss2	SPIM_SS2/GPIO32 Pad function 1

pad_spim_ss3	SPIM_SS3/GPIO33 Pad function 1
pad_spim_sck	SPIM_CLK/SPIS_CLK/GPIO34 Pad function 1
pad_spim_miso	SPIS_MISO/SPIM_MISO/GPIO35 Pad function 1
pad_spim_mosi	SPIS_MOSI/SPIM_MOSI/GPIO36 Pad function 1
pad_spim_io2	SPIS_SS/SPIM_IO2/GPIO37 Pad function 1
pad_spim_io3	RTC_REF/SPIM_IO3/GPIO38 Pad function 1
pad_vbus_dtc	VBUS_DTC/GPIO39 Pad function 1
pad_sd_clk	SD_CLK/SPIS_CLK/GPIO0 Pad function 2
pad_sd_cmd	SD_CMD/SPIS_MISO/GPIO1 Pad function 2
pad_sd_cd	SD_CD/SPIS_MOSI/GPIO2 Pad function 2
pad_sd_data0	SD_DATA0/SPIS_SS/GPIO3 Pad function 2
pad_sd_data1	PWM0/SD_DATA1/PWM7/GPIO4 Pad function 2
pad_sd_data2	PWM6/SD_DATA2/PWM1/GPIO5 Pad function 2
pad_sd_data3	SD_DATA3/PWM5/GPIO6 Pad function 2
pad_sd_wp	SD_WP/PWM4/GPIO7 Pad function 2
pad_i2cs_scl	I2CS_SCL/I2CM_SCL/GPIO12 Pad function 2
pad_i2cs_sda	I2CS_SDA/I2CM_SDA/GPIO13 Pad function 2
pad_uart3_rxd	UART3_RXD/UART2_DTR/GPIO18 Pad function 2
pad_uart3_txd	UART3_TXD/UART2_DSR/GPIO19 Pad function 2
pad_uart3_rts	UART3_RTS/UART2_DCD/GPIO20 Pad function 2
pad_uart3_cts	UART3_CTS/UART2_RI/GPIO21 Pad function 2
pad22_pwm3	PWM3/UART0_RXD/GPIO22 Pad function 1
pad23_pwm2	PWM2/UART0_TXD/GPIO23 Pad function 1
pad24_pwm1	PWM1/UART0_RTS/GPIO24 Pad function 2
pad25_pwm0	PWM0/UART0_CTS/GPIO25 Pad function 2
pad_uart1_txd	UART1_RXD/UART0_DTR/GPIO26 Pad function 2
pad_uart1_rxd	UART1_TXD/UART0_DSR/GPIO27 Pad function 2
pad_uart1_rts	UART1_RTS/UART0_DCD/GPIO28 Pad function 2
pad_uart1_cts	SPIM_SS0/UART1_CTS/UART0_RI/GPIO29 Pad function 2
pad_spis0_clk	SPIM_CLK/SPIS_CLK/GPIO34 Pad function 2
pad_spis0_miso	SPIS_MISO/SPIM_MISO/GPIO35 Pad function 2
pad_spis0_mosi	SPIS_MOSI/SPIM_MOSI/GPIO36 Pad function 2
pad_spis0_ss	SPIS_SS/SPIM_IO2/GPIO37 Pad function 2
pad_rtc_ref	RTC_REF/SPIM_IO3/GPIO38 Pad function 2
pad29_spim_ss0	SPIM_SS0/UART1_CTS/UART0_RI/GPIO29 Pad function 3
pad4_pwm0	PWM0/SD_DATA1/PWM7/GPIO4 Pad function 3
pad5_pwm1	PWM1/SD_DATA2/PWM6/GPIO5 Pad function 3

#### 2.4.3.5 *pad\_pull\_t*

enum pad\_pull\_t

Pad pull up and pull-down control.

Enumerator	
pad_pull_none	No pull up or pull down
pad_pull_pullup	Weak pull up enabled
pad_pull_pulldown	Weak pull down enabled
pad_pull_keeper	Weak pull up/down reflects output

#### 2.4.3.6 *pad\_schmitt\_t*

enum pad\_schmitt\_t

Pad Schmitt trigger control.

Enumerator	
pad_schmitt_off	Pad input is filtered through a schmitt trigger
pad_schmitt_on	Pad input is unfiltered

#### 2.4.3.7 *pad\_slew\_t*

enum pad\_slew\_t

Pad slew rate control.

Enumerator	
pad_slew_fast	Fast Slew Rate
pad_slew_slow	Slow Slew Rate

### 2.4.4 Function Documentation

#### 2.4.4.1 *gpio\_dir*

```
int8_t gpio_dir ( uint8_t    num,
                  pad_dir_t  dir
                )
```

Configure the direction of a pin.

##### Parameters

**num**      The GPIO number

**Dir**      The direction

##### Returns

On success a 0, otherwise -1

#### **2.4.4.2    *gpio\_function***

```
int8_t gpio_function ( uint8_t    num,  
                      pad_func_t func  
                      )
```

Configure the alternative function for a pin.

##### **Parameters**

**num**        The GPIO number  
**func**        The function that the pin should use

##### **Returns**

On success a 0, otherwise -1.

#### **2.4.4.3    *gpio\_idrive***

```
int8_t gpio_idrive ( uint8_t    num,  
                    pad_drive_t drive  
                    )
```

Configure the maximum current drive for a pin.

##### **Parameters**

**num**        The GPIO number  
**drive**       The maximum current

##### **Returns**

On success a 0, otherwise -1.

#### **2.4.4.4    *gpio\_pull***

```
int8_t gpio_pull ( uint8_t    num,  
                  pad_pull_t pull  
                  )
```

Configure the pull up/down for a pin.

##### **Parameters**

**num**        The GPIO number  
**pull**       The pullup/down configuration

##### **Returns**

On success a 0, otherwise -1.

#### **2.4.4.5    *gpio\_schmitt***

```
int8_t gpio_schmitt ( uint8_t    num,  
                    pad_schmitt_t schmitt  
                    )
```

Configure the schmitt trigger for a pin.

**Parameters**

**num** The GPIO number  
**schmitt** The Schmitt trigger configuration

**Returns**

On success a 0, otherwise -1.

**2.4.4.6 *gpio\_slew***

```
int8_t gpio_slew ( uint8_t    num,  
                  pad_slew_t  slew  
                  )
```

Configure the slew rate for a pin.

**Parameters**

**num** The GPIO number  
**slew** The slew rate of the pin

**Returns**

On success a 0, otherwise -1.

**2.4.4.7 *gpio\_read***

```
int8_t gpio_read ( uint8_t num )
```

Read a value from a GPIO pin.

**Parameters**

**num** The GPIO number

**Returns**

The value of the pin (1 = high, 0 = low), otherwise -1.

**2.4.4.8 *gpio\_write***

```
int8_t gpio_write ( uint8_t num,  
                   uint8_t val  
                   )
```

Write a value to a GPIO pin.

**Parameters**

**num** The GPIO number  
**val** The value to write

**Returns**

On success a 0, otherwise -1.

**2.4.4.9    *gpio\_toggle***

```
int8_t gpio_toggle ( uint8_t num )
```

Toggle the value of a GPIO pin.

**Parameters**

**num**    The GPIO number

**Returns**

On success a 0, otherwise -1.

**2.4.4.10   *gpio\_interrupt\_enable***

```
int8_t gpio_interrupt_enable ( uint8_t                num,  
                                                      gpio_int_edge_t edge  
                                                      )
```

Enable an interrupt on a GPIO pin.

**Parameters**

**num**    The GPIO number

**edge**    The edge at which to trigger on

**Returns**

On success a 0, otherwise -1.

**2.4.4.11   *gpio\_interrupt\_disable***

```
int8_t gpio_interrupt_disable ( uint8_t num )
```

Disable an interrupt on a GPIO pin.

**Parameters**

**num**    The GPIO number

**Returns**

On success a 0, otherwise -1.

**2.4.4.12   *gpio\_is\_interrupted***

```
int8_t gpio_is_interrupted ( uint8_t num )
```

Check if an interrupt has happened on a GPIO pin.

**Parameters**

**num**    The GPIO number

**Returns**

On no interrupt 0, on an interrupt 1, otherwise -1.

## 2.5 Assembler Definitions

The file **ft900\_asm.h** contains the definitions for assembler instructions used in the libft900.a and libft930.a libraries.

### 2.5.1 API Cross Reference

No additional definitions are required.

### 2.5.2 Macro Documentation

#### 2.5.2.1 *asm\_noop*

```
#define asm_noop()
```

A No Operation Instruction.

#### 2.5.2.2 *asm\_memcpy8*

```
#define asm_memcpy8(src, dst, size)
```

8-bitwise memory copy.

##### Parameters

- Src** A pointer to the source data.
- dst** A pointer to the destination data.
- size** The size of the data to copy.

#### 2.5.2.3 *asm\_memcpy16*

```
#define asm_memcpy16(src, dst, size)
```

16-bitwise memory copy.

##### Parameters

- Src** A pointer to the source data.
- dst** A pointer to the destination data.
- size** The size of the data to copy.

#### 2.5.2.4 *asm\_memcpy32*

```
#define asm_memcpy32(src, dst, size)
```

32-bitwise memory copy.

##### Parameters

- Src** A pointer to the source data.
- dst** A pointer to the destination data.
- size** The size of the data to copy.



#### **2.5.2.5 *asm\_memset8***

```
#define asm_memset8(val, dst, size)
```

8-bitwise memory set.

##### **Parameters**

**val** The value to set the memory to.  
**dst** A pointer to the destination data.  
**size** The size of the data to copy.

#### **2.5.2.6 *asm\_memset16***

```
#define asm_memset16(val, dst, size)
```

16-bitwise memory set.

##### **Parameters**

**val** The value to set the memory to.  
**dst** A pointer to the destination data.  
**size** The size of the data to copy.

#### **2.5.2.7 *asm\_memset32***

```
#define asm_memset32(val, dst, size)
```

32-bitwise memory set.

##### **Parameters**

**val** The value to set the memory to.  
**dst** A pointer to the destination data.  
**size** The size of the data to copy.

#### **2.5.2.8 *asm\_strcpy***

```
#define asm_strcpy(src, dst)
```

String copy.

##### **Parameters**

**Src** A pointer to the source string.  
**dst** A pointer to the destination string.

#### **2.5.2.9 *asm\_streamin8***

```
#define asm_streamin8 (src, dst, size)
```

8-bitwise memory stream from FIFO to memory.

##### **Parameters**

**Src** A pointer to the source registers.  
**dst** A pointer to the destination data.  
**size** The size of the data to copy.

**2.5.2.10 asm\_streamin16****#define asm\_streamin16(src, dst, size)**

16-bitwise memory stream from FIFO to memory.

**Parameters**

**Src** A pointer to the source registers.  
**dst** A pointer to the destination data.  
**size** The size of the data to copy.

**2.5.2.11 asm\_streamin32****#define asm\_streamin(src, dst, size)**

32-bitwise memory stream from FIFO to memory.

**Parameters**

**Src** A pointer to the source registers.  
**dst** A pointer to the destination data.  
**size** The size of the data to copy.

**2.5.2.12 asm\_streamout8****#define asm\_streamout8 (src, dst, size)**

8-bitwise memory stream from memory to FIFO.

**Parameters**

**Src** A pointer to the source data.  
**dst** A pointer to the destination registers.  
**size** The size of the data to copy.

**2.5.2.13 asm\_streamout16****#define asm\_streamin16(src, dst, size)**

16-bitwise memory stream from memory to FIFO.

**Parameters**

**Src** A pointer to the source data.  
**Dst** A pointer to the destination registers.  
**size** The size of the data to copy.

**2.5.2.14 asm\_streamout32****#define asm\_streamout(src, dst, size)**

32-bitwise memory stream from memory to FIFO.

**Parameters**

**src** A pointer to the source data.

**dst** A pointer to the destination registers.

**size** The size of the data to copy.

#### **2.5.2.15 *asm\_setbit***

**#define asm\_setbit(val, bit)**

Set a bit in a 32 bit value.

##### **Parameters**

**val** The value to use.

**bit** The bit position to set.

#### **2.5.2.16 *asm\_clrbit***

**#define asm\_clrbit(val, bit)**

Set a bit in a 32-bit value.

##### **Parameters**

**val** The value to use.

**bit** The bit position to clear.

#### **2.5.2.17 *asm\_flip32***

**#define asm\_flip32(src, dst, val)**

Flip bit regions.

##### **Parameters**

**src** A pointer to the source data.

**dst** A pointer to the destination data.

**val** The region of bits to flip.

- If bit 0 is set, then every alternate bit is exchanged.
- If bit 1 is set, then every alternate 2-bit group is exchanged.
- If bit 2 is set, then every alternate 4-bit group is exchanged.
- If bit 3 is set, then every alternate 8-bit group is exchanged.
- If bit 4 is set, then the two 16-bit groups are exchanged.

#### **2.5.2.18 *asm\_reverse\_endianness***

**#define asm\_reverse\_endianness (val)**

Reverse the endianness of a value.

##### **Parameters**

**val** The value to use.

#### **2.5.2.19 *asm\_reverse\_bits***

**#define asm\_reverse\_bits (val)**

Reverse the bits of a value.

##### **Parameters**

**val** The value to use.

#### **2.5.2.20 *asm\_rotate32***

**#define asm\_rotate32 (val, num)**

Rotate bits left or right.

##### **Parameters**

**val** The value to use.

**num** The number and direction to rotate in (negative numbers rotate left).

### **2.5.3 Function Documentation**

#### **2.5.3.1 *asm\_strcmp***

**static inline int32\_t asm\_strcmp(const char \*src1, const char \*src2)**

String compare.

##### **Parameters**

**src1** A pointer to the first source string.

**src2** A pointer to the second source string.

##### **Returns**

The difference between the two strings.

#### **2.5.3.2 *asm\_strlen***

**static inline int32\_t asm\_strlen(const char \*src)**

String length.

##### **Parameters**

**src** A pointer to the source string.

##### **Returns**

The length of the string.

## 2.6 Watchdog Timer

The file **ft900\_wdt.h** contains the definitions for the watchdog timer functions in the libft900.a and libft930.a libraries.

### 2.6.1 API Cross Reference

Additional definitions are taken from:

**ft900\_registers.h** – FT90x and FT93x register definitions

### 2.6.2 Enumeration Type Documentation

#### 2.6.2.1 *wdt\_counter\_t*

```
enum wdt_counter_t
```

Watchdog Timeouts.

Enumerator	
wdt_counter_1_clocks	10 nsec @ 100 MHz
wdt_counter_2_clocks	20 nsec @ 100 MHz
wdt_counter_4_clocks	40 nsec @ 100 MHz
wdt_counter_8_clocks	80 nsec @ 100 MHz
wdt_counter_16_clocks	160 nsec @ 100 MHz
wdt_counter_32_clocks	320 nsec @ 100 MHz
wdt_counter_64_clocks	640 nsec @ 100 MHz
wdt_counter_128_clocks	1.28 usec @ 100 MHz
wdt_counter_256_clocks	2.56 usec @ 100 MHz
wdt_counter_512_clocks	5.12 usec @ 100 MHz
wdt_counter_1K_clocks	10.24 usec @ 100 MHz
wdt_counter_2K_clocks	20.48 usec @ 100 MHz
wdt_counter_4K_clocks	40.96 usec @ 100 MHz
wdt_counter_8K_clocks	81.92 usec @ 100 MHz
wdt_counter_16K_clocks	163.84 usec @ 100 MHz
wdt_counter_32K_clocks	327.68 usec @ 100 MHz
wdt_counter_64K_clocks	655.35 usec @ 100 MHz
wdt_counter_128K_clocks	~1.31 msec @ 100 MHz
wdt_counter_256K_clocks	~2.62 msec @ 100 MHz
wdt_counter_512K_clocks	~5.24 msec @ 100 MHz
wdt_counter_1M_clocks	~10.49 msec @ 100 MHz
wdt_counter_2M_clocks	~20.97 msec @ 100 MHz
wdt_counter_4M_clocks	~41.94 msec @ 100 MHz
wdt_counter_8M_clocks	~83.89 msec @ 100 MHz
wdt_counter_16M_clocks	~167.77 msec @ 100 MHz
wdt_counter_32M_clocks	~335.54 msec @ 100 MHz

wdt_counter_64M_clocks	~671.09 msec @ 100 MHz
wdt_counter_128M_clocks	~1.34 sec @ 100 MHz
wdt_counter_256M_clocks	~2.68 sec @ 100 MHz
wdt_counter_512M_clocks	~5.37 sec @ 100 MHz
wdt_counter_1G_clocks	~10.74 sec @ 100 MHz
wdt_counter_2G_clocks	~21.47 sec @ 100 MHz

## 2.6.3 Function Documentation

### 2.6.3.1 *wdt\_init*

```
int8_t wdt_init ( wdt_counter_t timeout )
```

Initialise and start the Watchdog timer.

#### Parameters

**timeout** The timeout value of the Watchdog.

#### Returns

0 on success, -1 otherwise.

### 2.6.3.2 *wdt\_kick*

```
int8_t wdt_kick ( void )
```

Reset a running Watchdog Timer.

#### Returns

0 on success, -1 otherwise.

## 2.7 Timers

The file **ft900\_timers.h** contains the definitions for the timer management functions in the libft900.a and libft930.a libraries.

### 2.7.1 API Cross Reference

Additional definitions are taken from:

**ft900\_registers.h** – FT90x and FT93x register definitions

### 2.7.2 Enumeration Type Documentation

#### 2.7.2.1 *timer\_select\_t*

```
enum timer_select_t
```

Timer Select.

Enumerator	
timer_select_a	Timer A
timer_select_b	Timer B
timer_select_c	Timer C

timer_select_d	Timer D
----------------	---------

### 2.7.2.2 *timer\_direction\_t*

enum timer\_direction\_t

Timer count direction.

Enumerator	
timer_direction_up	Count up
timer_direction_down	Count down

### 2.7.2.3 *timer\_mode\_t*

enum timer\_mode\_t

Timer count mode.

Enumerator	
timer_mode_continuous	Count continuous
timer_mode_one-shot	Count one shot

### 2.7.2.4 *timer\_prescaler\_select\_t*

enum timer\_prescaler\_select\_t

Timer prescaler select.

Enumerator	
timer_prescaler_select_off	Timer prescaler off
timer_prescaler_select_on	Timer prescaler on

## 2.7.3 Function Documentation

### 2.7.3.1 *timer\_init*

```
int8_t timer_init ( timer_select_t      timer,
                   uint16_t             initial,
                   timer_direction_t     dir,
                   timer_prescaler_select_t prescaler,
                   timer_mode_t          mode
                   )
```

Initialise a timer.

#### Parameters

<b>timer</b>	The timer to set up
<b>initial</b>	The initial value for the timer
<b>dir</b>	The direction that the timer should count in

**prescaler** Whether or not this timer should use the prescaler

**mode** If the timer should be continuously counting or a one shot

### Returns

On success a 0, otherwise -1.

#### 2.7.3.2 *timer\_start*

```
int8_t timer_start ( timer_select_t timer )
```

Start a timer.

### Parameters

**timer** The timer to start

### Returns

On success a 0, otherwise -1.

#### 2.7.3.3 *timer\_stop*

```
int8_t timer_stop ( timer_select_t timer )
```

Stop a timer.

### Parameters

**timer** The timer to stop

### Returns

#### 2.7.3.4 *On success a 0, otherwise -1 timer\_read*

```
int8_t timer_read ( timer_select_t timer,  
                   uint16_t * value  
                   )
```

Read the value of a timer.

### Parameters

**timer** The timer to read from

**value** A pointer to store the value

### Returns

On success a 0, otherwise -1.

#### 2.7.3.5 *timer\_prescaler*

```
int8_t timer_prescaler ( uint16_t prescaler ) [FT90X Revision B]
```

```
int8_t timer_prescaler ( timer_select_t timer, uint16_t prescaler ) [FT93x and FT90x Revision C]
```

Set up the prescaler.

### Parameters

**prescaler** The clock prescaler to apply to the timer



**timer**      The timer to use [Only for FT93X]

**Returns**

On success a 0, otherwise -1.

**Warning**

This can only be used before starting timers.

**Note:**

FT93X and FT90X series Revision C devices have separate prescalers for each timer, while in FT90X Revision B, there is one common prescaler for all timers.

**2.7.3.6    *timer\_disable\_interrupt***

int8\_t timer\_disable ( timer\_select\_t timer )

Disable the interrupt for a timer.

**Parameters**

**timer**      The timer to disable the interrupt for

**Returns**

On success a 0, otherwise -1.

**2.7.3.7    *timer\_enable\_interrupt***

int8\_t timer\_enable\_interrupt ( timer\_select\_t timer )

Enable the interrupt for a timer.

**Parameters**

**timer**      The timer to enable the interrupt for

**Returns**

On success a 0, otherwise -1.

**2.7.3.8    *timer\_is\_interrupted***

int8\_t timer\_is\_interrupted ( timer\_select\_t timer )

Check if a timer has been interrupted.

**Parameters**

**timer**      The timer to check

**Warning**

This function clears the current interrupt status bit.

**Returns**

1 if a timer is interrupted, 0 if the timer is not interrupted, -1 otherwise.

## 2.8 Analogue to Digital Converter

The file **ft900\_adc.h** contains the definitions for the analogue-to-digital conversion functions in the libft900.a and libft930.a libraries.

### 2.8.1 API Cross Reference

It utilises the following library APIs:

**ft900\_asm.h** – FT90X and FT93X assembler definitions

Additional definitions are taken from:

**ft900\_registers.h** – FT90X and FT93X register definitions

### 2.8.2 Enumeration Type Documentation

#### 2.8.2.1 *adc\_mode\_t*

enum **adc\_mode\_t**

ADC Run Mode.

Enumerator	
adc_mode_single	One analogue reading will be taken and then the ADC stopped
adc_mode_continuous	The ADC will continuously acquire analogue readings

### 2.8.3 Function Documentation

#### 2.8.3.1 *adc\_start*

int8\_t **adc\_start** ( uint8\_t channel )

Start the ADC capturing.

##### Parameters

**channel**      The channel to select

##### Returns

0 on success, -1 otherwise.

#### 2.8.3.2 *adc\_stop*

int8\_t **adc\_stop** ( void )

Stop the ADC from capturing.

##### Returns

0 on success, -1 otherwise.

#### 2.8.3.3 *adc\_mode*

int8\_t **adc\_mode** (adc\_mode\_t mode)

Choose the mode that the ADC will run in.

##### Parameters

**mode**      The mode (single or continuous)

#### **2.8.3.4    *adc\_read***

```
int8_t adc_read ( uint16_t* val )
```

Get the next sample from the ADC.

##### **Parameters**

**val**      A pointer to store the sample

##### **Returns**

Only returns 1 which means success with 1 sample read.

#### **2.8.3.5    *adc\_readn***

```
Int adc_readn ( uint16_t* val,  
                size_t len  
                )
```

Get a collection of samples from the ADC and store it in the array passed as parameter.

##### **Parameters**

**val**      An array pointer to store the samples

**len**      The number of 10-bit word samples to read from the FIFO

##### **Warning**

This function will only work when the ADC is in continuous mode.

##### **Returns**

-1 if not in continuous mode. Otherwise, return the number of samples read.

#### **2.8.3.6    *adc\_available***

```
uint8_t adc_available ( void )
```

Get the number of ADC samples available.

##### **Returns**

The number of ADC samples

**Note:** In case of FT90x series Revision B, this function should be called in interrupt context for a reliable count of the ADC samples available. For FT90X Revision C or FT93X, this API can be used in interrupt or polling method of servicing the ADC application.

#### **2.8.3.7    *adc\_disable\_interrupt***

```
int8_t adc_disable_interrupt ( void )
```

Disable the Interrupt on the ADC.

##### **Returns**

0 on success, -1 otherwise.

### **2.8.3.8    *adc\_enable\_interrupt***

```
int8_t adc_enable_interrupt ( void )
```

Enable the Interrupt on the ADC.

#### **Returns**

0 on success, -1 otherwise.

### **2.8.3.9    *adc\_is\_interrupted***

```
int8_t adc_is_interrupted ( void )
```

Check that the ADC has been interrupted.

#### **Warning**

This function will clear the current interrupt bit when called.

#### **Returns**

1 interrupted, 0 not interrupted.

## **2.9 Digital to Analogue Converter**

The file **ft900\_dac.h** contains the definitions for the digital to analogue conversion functions in the libft900.a and libft930.a libraries.

### **2.9.1    API Cross Reference**

It utilises the following library APIs:

**ft900\_asm.h** – FT90X and FT93X assembler definitions

Additional definitions are taken from:

**ft900\_registers.h** – FT90X and FT93X register definitions

### **2.9.2    Enumeration Type Documentation**

#### **2.9.2.1    *dac\_mode\_t***

```
enum dac_mode_t
```

DAC run mode.

Enumerator	
dac_mode_single	Run the DAC in Single Shot mode
dac_mode_continuous	Run the DAC in Continuous mode

### **2.9.3    Function Documentation**

#### **2.9.3.1    *dac\_start***

```
int8_t dac_start ( uint8_t num )
```

Start the DAC.

#### **Parameters**

**num**    The DAC to use

**Returns**

0 on success, -1 otherwise

**2.9.3.2 *dac\_stop***

```
int8_t dac_stop ( uint8_t num )
```

Stop the DAC.

**Parameters**

**num**      The DAC to use

**Returns**

0 on success, -1 otherwise.

**2.9.3.3 *dac\_mode***

```
int8_t dac_mode ( uint8_t        num,  
                      dac_mode_t mode  
                      )
```

Select the mode of the DAC.

**Parameters**

**num**      The DAC to use

**mode**     The mode the DAC should be in (single or continuous)

**Returns**

0 on success, -1 otherwise

**2.9.3.4 *dac\_divider***

```
int8_t dac_divider ( uint8_t div )
```

Select the divider for the DAC conversion rate.

$f_{DAC} = f_{peripheral} / div + 1$

**Parameters**

**div**      The divider

**Warning**

The maximum conversion rate is 1 MHz.

**Returns**

0 on success, -1 otherwise

**2.9.3.5 *dac\_write***

```
int8_t dac_write ( uint8_t num,  
                      uint16_t data  
                      )
```

Write a value to the DAC.

This function will automatically update the DAC when it is in single mode.

**Parameters**

**num**        The DAC to use  
**data**        The sample to write

**Returns**

-1 if invalid DAC number. Otherwise, the number of bytes written.

**2.9.3.6    *dac\_writen***

```
int dac_writen ( uint8_t    num,  
                 uint16_t* data,  
                 size_t    len  
               )
```

Write a series of values to the DAC.

**Parameters**

**num**    The DAC to use  
**data**    The array of samples to write  
**len**    The number of samples to write

**Warning**

This function will only work when continuous mode is selected

**Returns**

-1 if invalid DAC number. Otherwise, the number of samples written.

**2.9.3.7    *dac\_available***

```
uint8_t dac_available ( uint8_t num )
```

See how many samples are still being converted.

**Parameters**

**num**    The DAC to use

**Returns**

The number of samples still to be converted, or 0 otherwise.

**2.9.3.8    *dac\_disable\_interrupt***

```
int8_t dac_disable_interrupt ( uint8_t num )
```

Disable the interrupt on a DAC.

**Parameters**

**num**    The DAC to use

**Returns**

0 on success, -1 otherwise.

### 2.9.3.9 ***dac\_enable\_interrupt***

```
int8_t dac_enable_interrupt ( uint8_t num )
```

Enable the interrupt on a DAC.

Enable the DAC module to generate an interrupt. The DAC module will generate an interrupt after 64 samples have been generated on the DAC.

#### **Parameters**

**num** The DAC to use

#### **Returns**

0 on success, -1 otherwise.

### 2.9.3.10 ***dac\_is\_interrupted***

```
int8_t dac_is_interrupted ( uint8_t num )
```

Check if the DAC has fired an interrupt.

#### **Parameters**

**num** The DAC to use

#### **Warning**

This function clears the current interrupt status bit.

#### **Returns**

1 when interrupted, 0 when not interrupted, -1 otherwise.

## 2.10 Ethernet driver

The file **ft900\_eth.h** contains the definitions for the Ethernet management and control functions in the libft900.a library.

### 2.10.1 API Cross Reference

It utilises the following library APIs:

**ft900\_sys.h** – Chip Management

**ft900\_gpio.h** – General Purpose I/O and Pad Control

Additional definitions are taken from:

**ft900\_registers.h** – FT90X register definitions

### 2.10.2 Enumeration Type Documentation

#### 2.10.2.1 ***ethernet\_led\_mode\_t***

```
enum ethernet_led_mode_t
```

Ethernet LED pin mode.

Enumerator	
ethernet_led_mode_link	Link active
ethernet_led_mode_tx	Transmit
ethernet_led_mode_rx	Receive

ethernet_led_mode_col	Collision
ethernet_led_mode_fdx	Full duplex
ethernet_led_mode_spd	Speed 10/100

### 2.10.3 Function Documentation

#### 2.10.3.1 *ethernet\_init*

```
void ethernet_init ( const uint8_t * mac )
```

Initialise the ethernet hardware.

##### Parameters

**mac** Pointer to a six-byte array containing MAC

#### 2.10.3.2 *ethernet\_tx\_enable*

```
void ethernet_tx_enable ( int flag )
```

Enable or disable the Ethernet transmitter.

##### Parameters

**flag** 0 - disable transmitter, 1 - enable transmitter

#### 2.10.3.3 *ethernet\_rx\_enable*

```
void ethernet_rx_enable ( int flag )
```

Enable or disable the Ethernet receiver.

##### Parameters

**flag** 0 - disable receiver, 1 - enable receiver

#### 2.10.3.4 *ethernet\_led\_mode*

```
void ethernet_led_mode ( uint8_t led,
                        ethernet_led_mode_t mode
                        )
```

Set the mode of the led.

##### Parameters

**led** The number of the led (0 or 1)

**mode** The mode which the led will be in

#### 2.10.3.5 *ethernet\_set\_mac*

```
void ethernet_set_mac ( const uint8_t * mac )
```

Set the Ethernet MAC.

##### Parameters

**mac** A pointer to a six-byte array containing MAC



### 2.10.3.6 *ethernet\_set\_promiscuous*

```
void ethernet_set_promiscuous ( int flag )
```

Set the Ethernet peripheral in promiscuous mode.

#### Parameters

**flag**      0 - reset promiscuous mode, 1 - set promiscuous mode

### 2.10.3.7 *ethernet\_read*

```
int ethernet_read ( size_t * blen,  
                   uint8_t * buf  
                   )
```

Poll the ethernet peripheral for the reception of a single packet.

#### Parameters

**buf**          Pointer to buffer to store the received packet.

**blen**         Size of reception buffer

#### Returns

1 packet received, 0 no packet received.

### 2.10.3.8 *ethernet\_mii\_read*

```
uint16_t ethernet_mii_read ( uint8_t reg )
```

Read the content of an MII register.

#### Parameters

**reg**          register to read

#### Returns

The content of requested register.

### 2.10.3.9 *ethernet\_write*

```
int ethernet_write ( uint8_t * buf,  
                    size_t blen  
                    )
```

Outputs a packet on the ethernet interface.

The buffer must be in the following format: To send (n) bytes.

Offset	Use
buf[0]	lsb of payload length (n & 0xff)
buf[1]	msb of payload length (n >> 16)
buf[2]	destination MAC[0]
buf[3]	destination MAC[1]
buf[4]	destination MAC[2]
buf[5]	destination MAC[3]

Offset	Use
buf[6]	destination MAC[4]
buf[7]	destination MAC[5]
buf[8]	source MAC[0]
buf[9]	source MAC[1]
buf[10]	source MAC[2]
buf[11]	source MAC[3]
buf[12]	source MAC[4]
buf[13]	source MAC[5]
buf[14]	packet type
buf[15]	packet type
buf[16]	payload
buf[.]	...
buf[n+16]	end of payload (n bytes)

#### Parameters

**buf** Pointer to packet to send

**blen** Length of packet to send (in bytes)

#### 2.10.3.10 ethernet\_mii\_write

```
int ethernet_mii_write ( uint8_t reg,
                        uint16_t v
                      )
```

Write a value to an MII register.

#### Parameters

**reg** Register to write to

**v** Value to write to requested register

#### Returns

0 on success, -1 on error.

#### 2.10.3.11 ethernet\_is\_link\_up

```
int ethernet_is_link_up ( void )
```

Return the Ethernet link status.

#### Returns

1 - link is up, 0 - link is not up.

#### 2.10.3.12 ethernet\_enable\_interrupt

```
void ethernet_enable_interrupt ( uint8_t mask )
```

Enable the Ethernet peripheral to fire interrupts.

## Parameters

**mask** - The bit mask to enable/disable corresponding interrupt.

## 2.11 UART

The file **ft900\_simple\_uart.h** contains the definitions for the UART management and control functions in the libft900.a library.

### 2.11.1 API Cross Reference

It utilises the following library APIs:

**ft900\_asm.h** – FT90X and FT93X assembler definitions

Additional definitions are taken from:

**ft900\_registers.h** – FT90X and FT93X register definitions

### 2.11.2 Macro Definition Documentation

```
#define UART_DIVIDER_1000000_BAUD (25)
```

Predefined divider for 1000000 baud.

```
#define UART_DIVIDER_110_BAUD (56818)
```

Predefined divider for 110 baud.

```
#define UART_DIVIDER_115200_BAUD (217)
```

Predefined divider for 115200 baud.

```
#define UART_DIVIDER_1200_BAUD (20833)
```

Predefined divider for 1200 baud.

```
#define UART_DIVIDER_150_BAUD (55555)
```

Predefined divider for 150 baud.

```
#define UART_DIVIDER_19200_BAUD (1302)
```

Predefined divider for 19200 baud.

```
#define UART_DIVIDER_230400_BAUD (109)
```

Predefined divider for 230400 baud.

```
#define UART_DIVIDER_2400_BAUD (10417)
```

Predefined divider for 2400 baud.

```
#define UART_DIVIDER_300_BAUD (27778)
```

Predefined divider for 300 baud.

```
#define UART_DIVIDER_31250_BAUD (800)
```

Predefined divider for 31250 baud.

```
#define UART_DIVIDER_38400_BAUD (651)
```

Predefined divider for 38400 baud.

```
#define UART_DIVIDER_460800_BAUD (54)
```

Predefined divider for 460800 baud.

```
#define UART_DIVIDER_4800_BAUD (5208)
```

Predefined divider for 4800 baud.

```
#define UART_DIVIDER_57600_BAUD (434)
```

Predefined divider for 57600 baud.

```
#define UART_DIVIDER_921600_BAUD (27)
```

Predefined divider for 921600 baud.

```
#define UART_DIVIDER_9600_BAUD (2604)
```

Predefined divider for 9600 baud.

### 2.11.3 Enumeration Type Documentation

#### 2.11.3.1 *uart\_data\_bits\_t*

```
enum uart_data_bits_t
```

UART Data bits.

Enumerator	
uart_data_bits_5	5 data bits
uart_data_bits_6	6 data bits
uart_data_bits_7	7 data bits
uart_data_bits_8	8 data bits

#### 2.11.3.2 *uart\_interrupt\_t*

```
enum uart_interrupt_t
```

UART Interrupts.

Enumerator	
uart_interrupt_none	No Interrupt
uart_interrupt_tx	Transmit Interrupt
uart_interrupt_rx	Receive Interrupt
uart_interrupt_dcd_ri_dsr_cts	DCD/RI/DSR/CTS Change Interrupt
uart_interrupt_xon_xoff	In-band flow control Interrupt (in 16950 mode only)
uart_interrupt_rts_cts	Out-of-band flow control Interrupt (in 16950 mode only)

#### 2.11.3.3 *uart\_parity\_t*

```
enum uart_parity_t
```

UART Parity bits.

Enumerator	
uart_parity_none	No parity
uart_parity_odd	Odd parity

uart_parity_even	Even parity
------------------	-------------

#### 2.11.3.4 *uart\_stop\_bits\_t*

enum uart\_stop\_bits\_t

UART Stop bits.

Enumerator	
uart_stop_bits_1	1 stop bit
uart_stop_bits_1_5	1.5 stop bit
uart_stop_bits_2	2 stop bit

#### 2.11.3.5 *uart\_flow\_t*

enum uart\_flow\_t

UART Flow control.

Enumerator	
uart_flow_none	No flow control
uart_flow_rts_cts	RTS/CTS flow control
uart_flow_dtr_dsr	DTR/DSR flow control
uart_flow_xon_xoff	XON/XOFF flow control

#### 2.11.3.6 *uart\_mode\_t*

enum uart\_mode\_t

UART Mode control.

Enumerator	
uart_mode_16450	16450 mode No FIFO enabled
uart_mode_16550	16550 mode 16 byte FIFO enabled
uart_mode_16650	16650 mode 128 byte FIFO enabled, autoRTS/CTS, XON/XOFF
uart_mode_16750	16750 mode 128 byte FIFO enabled, autoRTS/CTS
uart_mode_16950	16950 mode 128 byte FIFO enabled, autoRTS/CTS, autoDTR/DSR, XON/XOFF, RS485

### 2.11.4 Function Documentation

#### 2.11.4.1 *uart\_open*

```
int8_t uart_open ( ft900_uart_regs_t* dev,
                  uint8_t          prescaler,
                  uint32_t         divisor,
                  uart_data_bits_t databits,
                  uart_parity_t     parity,
                  uart_stop_bits_t stop
```

)

Open a UART for communication.

**Parameters**

<b>dev</b>	The device to use
<b>prescaler</b>	The value of the prescaler
<b>divisor</b>	The value of the divisor
<b>databits</b>	The number of data bits
<b>parity</b>	The parity scheme
<b>stop</b>	The number of stop bits

**Warning**

1.5 stop bits is only available in 5-bit mode.

**Returns**

0 on success, -1 otherwise (invalid device).

**2.11.4.2 *uart\_close***

```
int8_t uart_close ( ft900_uart_regs_t * dev )
```

Close a UART from communication.

**Parameters**

<b>dev</b>	The device to use
------------	-------------------

**Returns**

0 on success, -1 otherwise (invalid device).

**2.11.4.3 *uart\_calculate\_baud***

```
int32_t uart_calculate_baud ( uint32_t target_baud,  
                             uint8_t samples,  
                             uint32_t f_perif,  
                             uint16_t * divisor,  
                             uint8_t * prescaler  
                             )
```

Calculate the prescaler and divisor from a baudrate.

**Parameters**

<b>target_baud</b>	The baud rate to use
<b>samples</b>	The number of samples the UART will take for a bit, the default for this is 4
<b>f_perif</b>	Peripheral frequency, the default for this is 100,000,000
<b>divisor</b>	A pointer to store the divisor
<b>prescaler</b>	A pointer to store the prescaler, if this is NULL the prescaler will be set to 1

For Nsamples = 4, the following baud rates can be obtained from these Divisors and Prescalers:

Desired baud	Prescaler	Divisor	Actual Baud	Error
110	4	56818	110.00035	~0.000%
150	3	55555	150.00150	+0.001%
300	3	27778	299.99760	~0.000%
1200	1	20833	1200.01920	+0.002%
2400	1	10417	2399.92320	-0.003%
4800	1	5208	4800.30720	+0.006%
9600	1	2604	9600.61440	+0.006%
19200	1	1302	19201.2288	+0.006%
31250	1	800	31250.00000	0.000%
38400	1	651	38402.45800	+0.006%
57600	1	434	57603.68700	+0.006%
115200	1	217	115207.37000	+0.006%
230400	1	109	229357.80000	-0.452%
460800	1	54	462962.96000	-0.469%
921600	1	27	925925.93000	-0.469%
1000000	1	25	1000000.00000	0.000%

## Returns

The absolute error from the target baud rate.

### 2.11.4.4 *uart\_puts*

```
size_t uart_puts ( ft900_uart_regs_t * dev,
                  char *          str
                  )
```

Write a string to the serial port.

## Parameters

**dev** The device to use

**str** The null-terminated string to write

## Returns

-1 if unknown device. Otherwise, the number of bytes written.

### 2.11.4.5 *uart\_read*

```
size_t uart_read ( ft900_uart_regs_t * dev,
                  uint8_t *          buffer
                  )
```

Read a data word from a UART.

## Parameters

**dev** The device to use

**buffer** A pointer to the data word to store into

#### Returns

The number of bytes read or -1 otherwise (invalid device).

#### 2.11.4.6 *uart\_readn*

```
size_t uart_readn ( ft900_uart_regs_t * dev,
                   uint8_t *          buffer,
                   size_t              len
                   )
```

Read a series of data words from a UART.

#### Parameters

**dev** The device to use

**buffer** A pointer to the array of data words to store into

**len** The number of data words to read

#### Returns

The number of bytes read or -1 otherwise (invalid device).

#### 2.11.4.7 *uart\_write*

```
size_t uart_write ( ft900_uart_regs_t * dev,
                   uint8_t              buffer
                   )
```

Write a data word to a UART.

#### Parameters

**dev** The device to use

**buffer** The data to send

#### Returns

The number of bytes written or -1 otherwise (invalid device).

#### 2.11.4.8 *uart\_writen*

```
size_t uart_writen ( ft900_uart_regs_t * dev,
                   uint8_t *          buffer,
                   size_t              len
                   )
```

Write a series of data words to a UART.

#### Parameters

**dev** The device to use

**buffer** A pointer to the array to send



**len**      The size of buffer

#### Returns

The number of bytes written or -1 otherwise (invalid device).

#### 2.11.4.9 *uart\_is\_interrupted*

```
int8_t uart_is_interrupted ( ft900_uart_regs_t * dev,  
                           uart_interrupt_t   interrupt  
                           )
```

Check if an interrupt has been triggered.

#### Parameters

**dev**      The device to use

**interrupt**      The interrupt to check

#### Warning

This function clears the current interrupt status bit.

#### Returns

1 when interrupted, 0 when not interrupted, -1 otherwise (invalid device).

#### 2.11.4.10 *uart\_enable\_interrupt*

```
int8_t uart_enable_interrupt ( ft900_uart_regs_t * dev,  
                              uart_interrupt_t   interrupt  
                              )
```

Enable an interrupt on the UART.

#### Parameters

**dev**      The device to use

**interrupt**      The interrupt to enable

#### Returns

0 on success, -1 otherwise (invalid device).

#### 2.11.4.11 *uart\_enable\_interrupts\_globally*

```
int8_t uart_enable_interrupts_globally ( ft900_uart_regs_t * dev )
```

Enable a UART to interrupt.

#### Parameters

**dev**      The device to use

#### Returns

0 on success, -1 otherwise (invalid device).

**2.11.4.12 uart\_disable\_interrupt**

```
int8_t uart_disable_interrupt ( ft900_uart_regs_t * dev,  
                               uart_interrupt_t   interrupt  
                               )
```

Disable an interrupt on the UART.

**Parameters**

**dev**            The device to use  
**interrupt**    The interrupt to disable

**Returns**

0 on success, -1 otherwise (invalid device).

**2.11.4.13 uart\_disable\_interrupts\_globally**

```
int8_t uart_disable_interrupts_globally ( ft900_uart_regs_t * dev )
```

Disable a UART from interrupting.

**Parameters**

**dev**    The device to use

**Returns**

0 on success, -1 otherwise (invalid device).

**2.11.4.14 uart\_get\_interrupt**

```
uint8_t uart_get_interrupt(ft900_uart_regs_t *dev)
```

Return the currently indicated interrupt.

**Parameters**

**dev**    The device to use

**Returns**

enum of possible interrupt levels.

Cast to values defined in enum uart\_interrupt\_t or 0xff if invalid device.

**2.11.4.15 uart\_rts**

```
int8_t uart_rts(ft900_uart_regs_t *dev, int active)
```

Enable or disable RTS signal.

**Parameters**

**dev**            The device to use  
**active**        Non-zero to enable RTS (line high) zero to disable (line low)

**Returns**

0 on success or -1 otherwise (invalid device).

**2.11.4.16 uart\_dtr**

```
int8_t uart_dtr(ft900_uart_regs_t *dev, int active)
```

Enable or disable DTR signal.

**Parameters**

- dev**      The device to use
- active**    Non-zero to enable DTR (line high) zero to disable (line low)

**Returns**

0 on success or -1 otherwise (invalid device).

**2.11.4.17 uart\_cts**

```
int8_t uart_cts(ft900_uart_regs_t *dev)
```

Test status of CTS signal.

**Parameters**

- dev**      The device to use

**Returns**

1 when CTS enabled, 0 when not enabled, -1 otherwise (invalid device)

**2.11.4.18 uart\_dsr**

```
int8_t uart_dsr(ft900_uart_regs_t *dev)
```

Test status of DSR signal.

**Parameters**

- dev**      The device to use

**Returns**

1 when DSR enabled, 0 when not enabled, -1 otherwise (invalid device).

**2.11.4.19 uart\_ri**

```
int8_t uart_ri(ft900_uart_regs_t *dev)
```

Test status of RI signal.

**Parameters**

- dev**      The device to use

**Returns**

1 when RI enabled, 0 when not enabled, -1 otherwise (invalid device)

**2.11.4.20 uart\_dcd**

```
int8_t uart_dcd(ft900_uart_regs_t *dev)
```

Test status of DCD signal.

**Parameters**

- dev**      The device to use

**Returns**

1 when DCD enabled, 0 when not enabled, -1 otherwise (invalid device).

#### 2.11.4.21 *uart\_mode*

```
int8_t uart_mode(ft900_uart_regs_t *dev, uart_mode_t mode)
```

Set the mode of the UART. After the mode is selected all flow control and UART settings are reset. The `uart_open` function must be called again to re-initialise the UART.

##### Parameters

**dev** The device to use

**mode** The mode to select

##### Returns

0 if successful, -1 otherwise (invalid device).

## 2.12 I<sup>2</sup>C Master

The file **ft900\_i2cm.h** contains the definitions for the I2C master bus functions in the `libft900.a` and `libft930.a` libraries

### 2.12.1 API Cross Reference

It utilises the following library APIs:

**ft900\_asm.h** – FT90X and FT93X assembler definitions

Additional definitions are taken from:

**ft900\_registers.h** – FT90X and FT93X register definitions

### 2.12.2 Enumeration Type Documentation

#### 2.12.2.1 *I2CM\_speed\_mode*

```
enum I2CM_speed_mode
```

Available speed modes.

Enumerator	
I2CM_NORMAL_SPEED	Speed range: 98Kbps to 100 kbps
I2CM_FAST_SPEED	Speed range: 130Kbps to 400 kbps
I2CM_FAST_PLUS_SPEED	Speed range: 130Kbps to 1000 kbps
I2CM_HIGH_SPEED	Speed range: 529Kbps to 3400 kbps

#### 2.12.2.2 *I2CM\_clk\_speeds*

```
enum I2CM_clk_speeds
```

Some common I2C clock speeds.

Enumerator	
I2CM_100_Kbps	For 100 kbps
I2CM_400_Kbps	For 400 kbps
I2CM_1000_Kbps	For 1000 kbps
I2CM_3400_Kbps	For 3400 kbps

### 2.12.3 Function Documentation

#### 2.12.3.1 *i2cm\_init*

```
void i2cm_init ( I2CM_speed_mode mode,  
                uint32_t          i2c_clk_speed  
                )
```

Call once, to initialise the master and reset it to a known state.

It is not valid to call any other I2C Master functions before this one.

##### Parameters

[in] **mode** I2C Master Clock mode

[in] **i2c\_clk\_speed** The clock rate of the I2C bus.  
Enums of I2C\_clk\_speeds can be used.

#### 2.12.3.2 *i2cm\_read*

```
int8_t i2cm_read ( const uint8_t addr,  
                  const uint8_t cmd,  
                  uint8_t* data,  
                  const uint16_t number_to_read  
                  )
```

Read a specified number of bytes from an I2C device.

Automatically adopts burst mode if the slave supports it, and more than one byte is to be read.

##### Parameters

[in] **addr** I2C address to write to.

[in] **cmd** I2C command byte

[in] **data** Buffer containing bytes to write.

[in] **number\_to\_read** Number of bytes to read.

##### Returns

0 on success, -1 on error.

#### 2.12.3.3 *i2cm\_write*

```
int8_t i2cm_write ( const uint8_t addr,  
                   const uint8_t cmd,  
                   const uint8_t* data,  
                   const uint16_t number_to_write  
                   )
```

Write a specified number of bytes to an I2C device.

Automatically adopts burst mode if the slave supports it, and more than one byte is to be written.

## Parameters

[in] <b>addr</b>	I2C address to write to.
[in] <b>cmd</b>	I2C command byte
[in] <b>data</b>	Buffer containing bytes to write.
[in] <b>number_to_write</b>	Number of bytes to read.

## Returns

0 on success, -1 on error.

### 2.12.3.4 i2cm\_get\_status

```
uint8_t i2cm_get_status ( void )
```

Determine I2C Master status.

Bit	Mask Name	Set when...
0 (LSB)	MASK_I2CM_STATUS_I2C_BUSY	The Bus is currently busy transmitting/receiving
1	MASK_I2CM_STATUS_I2C_ERR	An error occurred (ADDR_ACK, DATA_ACK, ARB_LOST)
2	MASK_I2CM_STATUS_ADDR_ACK	Slave address was not acknowledged
3	MASK_I2CM_STATUS_DATA_ACK	Data was not acknowledged
4	MASK_I2CM_STATUS_ARB_LOST	Arbitration lost
5	MASK_I2CM_STATUS_I2C_IDLE	The I2C Controller is idle
6	MASK_I2CM_STATUS_BUS_BUSY	The I2C Bus is busy
7 (MSB)	-	-

## Returns

0 on success, -1 on error.

### 2.12.3.5 i2cm\_interrupt\_disable

```
int8_t i2cm_interrupt_disable ( uint8_t mask )
```

Disable an interrupt.

## See also

i2cm\_interrupt\_enable

## Parameters

**mask** The bit pattern of interrupts to disable

## Returns

0 on success, -1 on error.

### 2.12.3.6 i2cm\_interrupt\_enable

```
int8_t i2cm_interrupt_enable ( uint8_t mask )
```

Enable an interrupt.

## Parameters

**mask** The bit pattern of interrupts to enable

Bit	Mask Name	Interrupts on...
0 (LSB)	MASK_I2CM_FIFO_INT_ENABLE_TX_EMPTY	When the Transmit FIFO is empty
1	MASK_I2CM_FIFO_INT_ENABLE_TX_HALF	When the Transmit FIFO is half empty
2	MASK_I2CM_FIFO_INT_ENABLE_TX_FULL	When the Transmit FIFO is full
3	MASK_I2CM_FIFO_INT_ENABLE_RX_EMPTY	When the Receive FIFO is empty
4	MASK_I2CM_FIFO_INT_ENABLE_RX_HALF	When the Receive FIFO is half full
5	MASK_I2CM_FIFO_INT_ENABLE_RX_FULL	When the Receive FIFO is full
6	MASK_I2CM_FIFO_INT_ENABLE_I2C_INT	When an operation is complete on the I2C Master
7 (MSB)	MASK_I2CM_FIFO_INT_ENABLE_DONE	

### Returns

0 on success, -1 on error.

#### 2.12.3.7 *i2cm\_is\_interrupted*

```
int8_t i2cm_is_interrupted ( uint8_t mask )
```

Check that an interrupt has been fired.

### See also

`i2cm_interrupt_enabled`

### Parameters

**mask** The bit pattern of interrupts to check

### Returns

1 if the interrupt has been fired, 0 if the interrupt has not been fired, -1 otherwise.

## 2.13 I<sup>2</sup>C Slave

The file **ft900\_i2cs.h** contains the definitions for the I2C slave bus functions in the libft900.a library.

### 2.13.1 API Cross Reference

It utilises the following library APIs:

**ft900\_asm.h** – FT90X and FT93X assembler definitions

Additional definitions are taken from:

**ft900\_registers.h** – FT90X and FT93X register definitions

### 2.13.2 Function Documentation

#### 2.13.2.1 *i2cs\_init*

```
void i2cs_init ( uint8_t addr )
```

Call once, to initialise the slave and reset it to a known state.

### Parameters

[in] **addr** Slave (read or write) address.

**2.13.2.2 i2cs\_is\_interrupted**

```
int8_t i2cs_is_interrupted ( uint8_t mask )
```

Check the status of an interrupt.

**Parameters**

[in] **mask**      The bit pattern of interrupts to check.

**Returns**

- 1 - If the interrupt has been fired.
- 0 - If the interrupt has not been fired.

**2.13.2.3 i2cs\_read**

```
int8_t i2cs_read ( uint8_t * data,  
                  size_t    size  
                  )
```

Read a specified number of bytes from the I2C Slave.

This transaction is orchestrated by the I2C Master. The number of bytes written may be less than the number requested if the master terminates the transaction early.

**Parameters**

[out] **data**      Caller-allocated buffer to receive any bytes read.

[in] **size**        The number of bytes to read.

**Returns**

0 on success, -1 on error.

**2.13.2.4 i2cs\_write**

```
int8_t i2cs_write ( const uint8_t * data,  
                   size_t          size  
                   )
```

Write a specified number of bytes to an open device.

This transaction is orchestrated by the I2C Master. The number of bytes written may be less than the number requested if the master terminates the transaction early.

**Parameters**

[in] **data**        Buffer containing bytes to write.

[in] **size**        The number of bytes to write.

**Returns**

0 on success, -1 on error.

**2.13.2.5 i2cs\_get\_status**

```
uint8_t i2cs_get_status ( void )
```

Determine I2C Slave status.



Bit	Mask Name	Set when...
0 (LSB)	MASK_I2CS_STATUS_RX_REQ	The slave controller head received data
1	MASK_I2CS_STATUS_TX_REQ	The slave controller is transmitter and requires data
2	MASK_I2CS_STATUS_SEND_FIN	The master has ended the receive operation
3	MASK_I2CS_STATUS_REC_FIN	The master has ended the transmit operation
4	MASK_I2CS_STATUS_BUS_ACTV	The bus is currently busy with an operation
5	-	-
6	MASK_I2CS_STATUS_DEV_ACTV	The slave controller is enabled
7 (MSB)	-	-

### Returns

Returns the status byte of the I2C Slave Status register.

#### 2.13.2.6 *i2cs\_disable\_interrupt*

```
int8_t i2cs_disable_interrupt ( uint8_t mask )
```

Disable an interrupt.

### Parameters

**mask** The bit pattern of interrupts to disable

### Returns

0 on success, -1 on error.

#### 2.13.2.7 *i2cs\_enable\_interrupt*

```
int8_t i2cs_enable_interrupt ( uint8_t mask )
```

Enable an interrupt.

### Parameters

**mask** The bit pattern of interrupts to enable

### Returns

0 on success, -1 on error.

## 2.14 I<sup>2</sup>S Audio

The file **ft900\_i2s.h** contains the definitions for the I2S bus functions in the libft900.a library.

### 2.14.1 API Cross Reference

It utilises the following library APIs:

**ft900\_asm.h** – FT90X assembler definitions

Additional definitions are taken from:

**ft900\_registers.h** – FT90X register definitions

## 2.14.2 Enumeration Type Documentation

### 2.14.2.1 *i2s\_mode\_t*

enum i2s\_mode\_t

I2S mode definitions.

Enumerator	
i2s_mode_slave	I2S Slave
i2s_mode_master	I2S Master

### 2.14.2.2 *i2s\_format\_t*

enum i2s\_format\_t

I2S format definitions.

Enumerator	
i2s_format_i2s	I2S format
i2s_format_leftjust	Left justified format
i2s_format_rightjust	Right justified format

### 2.14.2.3 *i2s\_length\_t*

enum i2s\_length\_t

I2S data length definitions.

Enumerator	
i2s_length_16	16 bit data length
i2s_length_20	20 bit data length
i2s_length_24	24 bit data length
i2s_length_32	32 bit data length

### 2.14.2.4 *i2s\_padding\_t*

enum i2s\_padding\_t

I2S padding definitions.

Enumerator	
i2s_padding_0	No padding
i2s_padding_4	4 bits of padding
i2s_padding_8	8 bits of padding
i2s_padding_12	12 bits of padding
i2s_padding_16	16 bits of padding

### 2.14.2.5 *i2s\_bclk\_div*

enum i2s\_bclk\_div

I2S BCLK speed definitions.

Enumerator	
i2s_bclk_div_1	Divide BCLK by 1
i2s_bclk_div_2	Divide BCLK by 2
i2s_bclk_div_3	Divide BCLK by 3
i2s_bclk_div_4	Divide BCLK by 4
i2s_bclk_div_6	Divide BCLK by 6
i2s_bclk_div_8	Divide BCLK by 8
i2s_bclk_div_12	Divide BCLK by 12
i2s_bclk_div_16	Divide BCLK by 16
i2s_bclk_div_24	Divide BCLK by 24
i2s_bclk_div_32	Divide BCLK by 32
i2s_bclk_div_48	Divide BCLK by 48
i2s_bclk_div_64	Divide BCLK by 64

#### 2.14.2.6 i2s\_mclk\_div\_t

enum i2s\_mclk\_div\_t

I2S MCLK speed definitions.

Enumerator	
i2s_mclk_div_1	Divide MCLK by 1
i2s_mclk_div_2	Divide MCLK by 2
i2s_mclk_div_3	Divide MCLK by 3
i2s_mclk_div_4	Divide MCLK by 4
i2s_mclk_div_6	Divide MCLK by 6
i2s_mclk_div_8	Divide MCLK by 8
i2s_mclk_div_12	Divide MCLK by 12
i2s_mclk_div_16	Divide MCLK by 16
i2s_mclk_div_24	Divide MCLK by 24
i2s_mclk_div_32	Divide MCLK by 32
i2s_mclk_div_48	Divide MCLK by 48
i2s_mclk_div_64	Divide MCLK by 64

#### 2.14.2.7 i2s\_bclk\_per\_channel\_t

enum i2s\_bclk\_per\_channel\_t

I2S BCLK cycles per channel, used in master mode only.

Enumerator	
i2s_bclk_per_channel_16	16 BCLK per channel
i2s_bclk_per_channel_32	32 BCLK per channel

### 2.14.2.8 i2s\_master\_input\_clk\_t

enum i2s\_master\_input\_clk\_t

I2S master input clk frequency definitions.

Enumerator	
i2s_master_input_clk_22mhz	22.5792 MHz Master clock
i2s_master_input_clk_24mhz	24.576 MHz Master clock

### 2.14.2.9 i2s\_rx\_t

enum i2s\_rx\_t

I2S RX definitions.

Enumerator	
i2s_rx_disabled	Receive Disabled
i2s_rx_enabled	Receive Enabled

### 2.14.2.10 i2s\_tx\_t

enum i2s\_tx\_t

I2S TX definitions.

Enumerator	
i2s_tx_disabled	Transmit Disabled
i2s_tx_enabled	Transmit Enabled

## 2.14.3 Function Documentation

### 2.14.3.1 i2s\_init

```
void i2s_init ( i2s_mode_t          mode,
               i2s_length_t        length,
               i2s_format_t        format,
               i2s_padding_t       padding,
               i2s_master_input_clk_t mclk_in,
               i2s_bclk_div        bclk_div,
               i2s_mclk_div_t      mclk_div,
               i2s_bclk_per_channel_t bclk_per_channel
             )
```

Call once, to initialise the peripheral and reset it to a known state.

#### Parameters

[in] <b>mode</b>	The I2S Mode
[in] <b>length</b>	The transfer length

[in] <b>format</b>	The format of the transfer
[in] <b>padding</b>	The number of padding bits that have been added to the transfer
[in] <b>mclk_in</b>	The MCLK to use
[in] <b>bclk_div</b>	The BCLK divider
[in] <b>mclk_div</b>	The MCLK divider
[in] <b>bclk_per_channel</b>	The number of BCLK per channel

#### **2.14.3.2 i2s\_start\_rx**

```
void i2s_start_rx ( void )
```

Start reception of the I2S Module.

#### **2.14.3.3 i2s\_start\_tx**

```
void i2s_start_tx ( void )
```

Start transmission of the I2S Module.

#### **2.14.3.4 i2s\_stop\_rx**

```
void i2s_stop_rx ( void )
```

Stop reception of the I2S Module.

#### **2.14.3.5 i2s\_stop\_tx**

```
void i2s_stop_tx ( void )
```

Stop transmission of the I2S Module.

#### **2.14.3.6 i2s\_read**

```
size_t i2s_read ( uint8_t* data,
                  const size_t num_bytes
                )
```

Reads x number of bytes from the I2S FIFO.

#### **Parameters**

[out] <b>data</b>	Caller-allocated buffer to receive any bytes read.
[in] <b>num_bytes</b>	Number of bytes to read from the FIFO.

#### **2.14.3.7 i2s\_write**

```
size_t i2s_write ( const uint8_t* data,
                   const size_t num_bytes
                 )
```

Writes x number of bytes to the I<sup>2</sup>S FIFO.

**Warning**

Due to the hardware implementation of the I2S interface, 24-bit input must be converted to a 32-bit word by software before being written to the I2S interface. This can affect the speed of the interface.

**Parameters**

- [in] **data** Buffer containing bytes to write.
- [in] **num\_bytes** Number of bytes to write to the FIFO.

**2.14.3.8 i2s\_get\_status**

```
uint16_t i2s_get_status ( void )
```

Determine I2S status.

Get the status of the interrupts on the I2S module.

**Returns**

Returns the status of the I2S peripheral (the copy of the Interrupt Status Register).

**2.14.3.9 i2s\_get\_rx\_count**

```
uint16_t i2s_get_rx_count ( void )
```

Get the receive count of the I2S Module.

**Returns**

The number of receptions that have been made.

**2.14.3.10 i2s\_get\_tx\_count**

```
uint16_t i2s_get_tx_count ( void )
```

Get the transmit count of the I2S Module.

**Returns**

The number of transmissions that have been made.

**2.14.3.11 i2s\_disable\_int**

```
void i2s_disable_int ( uint16_t mask )
```

Disable interrupts on the I2S module.

**Parameters**

**mask** The mask of bits to disable

**See also**

i2s\_enable\_int

### 2.14.3.12 *i2s\_enable\_int*

```
void i2s_enable_int ( uint16_t mask )
```

Enable interrupts on the I2S module.

Bit	Mask Name	Interrupts when...
0 (LSB)	MASK_I2S_IE_FIFO_TX_UNDER	Transmit FIFO has underflowed
1	MASK_I2S_IE_FIFO_TX_EMPTY	Transmit FIFO is empty
2	MASK_I2S_IE_FIFO_TX_HALF_FULL	Transmit FIFO is half empty
3	MASK_I2S_IE_FIFO_TX_FULL	Transmit FIFO is full
4	MASK_I2S_IE_FIFO_TX_OVER	Transmit FIFO has overflowed
5	-	-
6	-	-
7	-	-
8	MASK_I2S_IE_FIFO_RX_UNDER	Receive FIFO has underflowed
9	MASK_I2S_IE_FIFO_RX_EMPTY	Receive FIFO is empty
10	MASK_I2S_IE_FIFO_RX_HALF_FULL	Receive FIFO is half empty
11	MASK_I2S_IE_FIFO_RX_FULL	Receive FIFO is full
12	MASK_I2S_IE_FIFO_RX_OVER	Receive FIFO has overflowed
13	-	-
14	-	-
15 (MSB)	-	-

#### Parameters

**mask** The mask of bits to enable

### 2.14.3.13 *i2s\_clear\_int\_flag*

```
void i2s_clear_int_flag ( uint16_t mask )
```

Clear interrupt flags on the I2S module.

#### Parameters

**mask** The mask of bits to clear

### 2.14.3.14 *i2s\_is\_interrupted*

```
int8_t i2s_is_interrupted ( uint16_t mask )
```

Check if an interrupt has been fired.

#### Warning

This function will clear the current interrupts you are checking for.

#### Parameters

**mask** The mask of interrupts to check for

#### Returns

1 when an interrupt has fired, 0 otherwise.

#### See also

*i2s\_enable\_int*

## 2.15 SPI Bus

The file **ft900\_spi.h** contains the definitions for the SPI Master and Slave bus functions in the libft900.a library.

### 2.15.1 API Cross Reference

Additional definitions are taken from:

**ft900\_registers.h** – FT90X and FT93X register definitions

### 2.15.2 Enumeration Type Documentation

#### 2.15.2.1 *enum spi\_clock\_mode\_t*

The SPI mode.

Enumerator	
spi_mode_0	CPOL = 0, CPHA = 0
spi_mode_1	CPOL = 0, CPHA = 1
spi_mode_2	CPOL = 1, CPHA = 0
spi_mode_3	CPOL = 1, CPHA = 1

#### 2.15.2.2 *enum spi\_option\_t*

SPI Options.

Enumerator	
spi_option_fifo	Enable or disable the FIFO
spi_option_fifo_size	Set the size of the FIFO
spi_option_fifo_receive_trigger	Set the FIFO trigger level
spi_option_force_ss_assertions	Force SS to go low in assert
spi_option_bus_width	Set the SPI bus width
spi_option_multi_receive	Set the SPI device to clock in data without loading it into the RX FIFO
spi_option_fifo_transmit_trigger	Set the FIFO transmit trigger level
spi_option_baud_factor	Applicable in FT93X and FT90X Revision C. SCK frequency is determined by BAUD FACTOR (divided by 2 to divided by 256)
spi_option_fast_spi	Applicable ONLY in FT90X Revision C. The master clock is set to CLK (system clock)/2
spi_option_change_spi_rate	SCK frequency is determined by CHG_SPI and SPR[0:2] bits (CLK gets divided 2 to divided by 511)
spi_option_ignore_incoming	Not supported as of now.

#### 2.15.2.3 *enum spi\_dir\_t*

SPI Direction.

Enumerator	
spi_dir_slave	The SPI Device is in Slave mode



spi_dir_master	The SPI Device is in Master mode
----------------	----------------------------------

#### 2.15.2.4 enum spi\_fifo\_size\_t

SPI FIFO size.

Enumerator	
spi_fifo_size_16	Use a 16 level FIFO
spi_fifo_size_64	Use a 64 Byte FIFO

#### 2.15.2.5 enum spi\_width\_t

SPI Data Bus Width.

Enumerator	
spi_width_1bit	The SPI Device is working in 1 bit wide mode (i.e. 4 wire SPI)
spi_width_2bit	The SPI Device is working in 2 bit wide mode
spi_width_4bit	The SPI Device is working in 4 bit wide mode

#### 2.15.2.6 enum spi\_ss\_assertions\_t

SS Assertion control.

Enumerator	
spi_ss_assertions_force	SS will reflect the status of SPISS
spi_ss_assertions_auto	SS will go low during transmissions if selected

#### 2.15.2.7 enum spi\_interrupt\_t

SPI Interrupts

**NOTE:** Call spi\_is\_interrupted() to clear interrupt flags.

Enumerator	
spi_interrupt_transmit_empty	Either the FIFO or the data register are empty.
spi_interrupt_data_ready	A transmission or reception was completed <i>or</i> the FIFO was filled to a trigger level.
spi_interrupt_transmit_1bit_complete	Transmission was complete when using the SPI1BIT method.
spi_interrupt_fault	The SPI device was asserted when in Master mode.

### 2.15.3 Function Documentation

#### 2.15.3.1 spi\_init

```
int8_t spi_init ( ft900_spi_regs_t * dev,
                 spi_dir_t          dir,
                 spi_clock_mode_t   clock_mode,
```

```
uint16_t div
    )
```

Initialise the SPI device.

#### Parameters

<b>dev</b>	The device to use
<b>dir</b>	The direction for the device to work in (Master/Slave)
<b>clock_mode</b>	The SPI Clock mode to use
<b>div</b>	The clock divider to use (4,8,16,32,64,128,256,512)

#### Returns

0 on a success or -1 for a failure.

#### Warning

This will reset the peripheral and all options.

#### 2.15.3.2 *spi\_open*

```
int8_t spi_open ( ft900_spi_regs_t * dev,
                  uint8_t num
    )
```

Select a device to start communicating with.

#### Parameters

<b>dev</b>	The device to use
<b>num</b>	The device to select

#### Returns

0 on a success or -1 for a failure.

#### 2.15.3.3 *spi\_close*

```
int8_t spi_close ( ft900_spi_regs_t * dev,
                   uint8_t num
    )
```

Stop communicating with a certain device.

#### Parameters

<b>dev</b>	The device to use
<b>num</b>	The device to select

#### Returns

0 on a success or -1 for a failure.

#### **2.15.3.4 spi\_read**

```
int32_t spi_read ( ft900_spi_regs_t * dev,  
                  uint8_t          b  
                  )
```

Reads a byte from the SPI device.

Reads a byte by writing a dummy byte into the SPI bus.

##### **Parameters**

**dev**      The device to use  
**b**        A variable to store the byte

##### **Returns**

The number of bytes read or -1 for a failure.

#### **2.15.3.5 spi\_readn**

```
int32_t spi_readn ( ft900_spi_regs_t * dev,  
                   uint8_t *          b,  
                   size_t             len  
                   )
```

Reads several bytes from the SPI device.

Reads len number of bytes by writing len number of bytes into SPI bus.

##### **Parameters**

**dev**      The device to use  
**b**        A pointer to the array to read into  
**len**      The number of bytes to read

##### **Returns**

The number of bytes read or -1 for a failure.

#### **2.15.3.6 spi\_write**

```
int32_t spi_write ( ft900_spi_regs_t * dev,  
                   uint8_t          b  
                   )
```

Writes a byte to the SPI device.

##### **Parameters**

**dev**      The device to use  
**b**        The byte to send

##### **Returns**

The number of bytes written or -1 for a failure.

### 2.15.3.7 *spi\_writen*

```
int32_t spi_writen ( ft900_spi_regs_t * dev,  
                    const uint8_t *   b,  
                    size_t            len  
                    )
```

Writes several bytes to the SPI device.

#### Parameters

**dev**     The device to use  
**b**        A pointer to the array to sendspi\_open  
**len**     The number of bytes to write

#### Returns

The number of bytes written or -1 for a failure.

### 2.15.3.8 *spi\_xchange*

```
int32_t spi_xchange ( ft900_spi_regs_t * dev,  
                     uint8_t            b,  
                     uint8_t            c  
                     )
```

Exchange a byte to the SPI device. Supports single channel mode only.

#### Parameters

**dev**     The device to use  
**b**        A variable to send the byte  
**c**        A variable to store the byte

#### Returns

The number of bytes exchanged or -1 for failure.

### 2.15.3.9 *spi\_xchangen*

```
int32_t spi_xchangen ( ft900_spi_regs_t * dev,  
                      uint8_t *          binp,  
                      uint8_t *          bout,  
                      size_t            len  
                      )
```

Exchange several bytes to the SPI device. Supports single channel mode only.

#### Parameters

**dev**        The device to use  
**binp**      A pointer to the array to send

**bout** A pointer to the array to receive

**len** The number of bytes to exchange

### Returns

The number of bytes exchanged or -1 for a failure.

#### 2.15.3.10 spi\_status

```
uint8_t spi_status ( ft900_spi_regs_t * dev )
```

Return the status register.

Bit	Name	When set to 1	When set to 0
0	AUTOSS	Auto SS Assertions Enabled	SSO always shows contents of SSCR
1	RXFULL	Receiver FIFO is full	Receiver FIFO is not full
2	EMPTY	TX FIFO or TX register empty	TX FIFO or TX register not empty
3	IDLE	SPI Device Idle	Transmission in progress
4	FAULT	Mode Fault (SS Low in Master mode)	-
5	1BITTX	End of TX from SPDR BIS Register	-
6	WCOL	Data Register Write Collision occurred	-
7	IRQ	An interrupt occurred	-

### Parameters

**dev** The device to use

### Returns

A copy of the SPISTAT register.

#### 2.15.3.11 spi\_option

```
int8_t spi_option ( ft900_spi_regs_t * dev,
                   spi_option_t      opt,
                   uint8_t            val
                   )
```

Control the SPI device.

This function will set various options for the driver.

Option	Description	Values
spim_option_fifo	Enable or disable the FIFO	0 = Disabled (Default) 1 = Enabled [Note 1]
spim_option_fifo_size	Set the size of the FIFO	16 = 16 Byte FIFO (default) 64 = 64 Byte FIFO
spim_option_fifo_receive_trigger	Set the FIFO trigger level	For 16 Byte FIFOs: 1, 4, 8, 14 For 64 Byte FIFOs: 1, 16, 32, 56
spim_option_force_ss_assertions	Force SS to go low in assert	0 = Automatic Assertions 1 = Force Assertions (Default)
spim_option_bus_width	Set the SPI bus width	1 = Single (Default) 2 = Dual 4 = Quad

spim_option_dual_quad_direction	Set the multi-bit direction	0 = Read 1 = Write
---------------------------------	-----------------------------	-----------------------

**Note 1:** Enabling the FIFO will cause the driver to clear its contents.

#### Parameters

**dev** The device to use  
**opt** The option to configure  
**val** The value to use

#### Returns

0 on a success or -1 for a failure.

#### 2.15.3.12 spi\_disable\_interrupt

```
int8_t spi_disable_interrupt ( ft900_spi_regs_t * dev,
                             spi_interrupt_t  interrupt
                             )
```

Disables an interrupt for the SPI device.

#### Parameters

**dev** The device to use  
**interrupt** The interrupt to disable

#### Returns

0 on a success or -1 for a failure.

#### See also

spim\_disable\_interrupts\_globally

#### 2.15.3.13 spi\_disable\_interrupts\_globally

```
int8_t spi_disable_interrupts_globally ( ft900_spi_regs_t * dev )
```

Disables the SPI device from generating an interrupt.

#### Parameters

**dev** The device to use

#### Returns

0 on a success or -1 for a failure.

#### 2.15.3.14 spi\_enable\_interrupt

```
int8_t spi_enable_interrupt ( ft900_spi_regs_t * dev,
                             spi_interrupt_t  interrupt
                             )
```

Enables an interrupt for the SPI device.

#### Parameters

**dev** The device to use

**interrupt**      The interrupt to enable

**Returns**

0 on a success or -1 for a failure.

**See also**

`spim_enable_interrupts_globally`

**2.15.3.15 *spi\_enable\_interrupts\_globally***

```
int8_t spi_enable_interrupts_globally ( ft900_spi_regs_t * dev )
```

Enables the SPI device to generate an interrupt.

**Parameters**

**dev**            The device to use

**Returns**

0 on a success or -1 for a failure.

**2.15.3.16 *spi\_is\_interrupted***

```
int8_t spi_is_interrupted ( ft900_spi_regs_t * dev,  
                           spi_interrupt_t    interrupt  
                           )
```

Disables an interrupt for the QSPI device.

**Parameters**

**dev**            The device to use

**interrupt**      The interrupt to check

**Returns**

1 when interrupted, 0 when not interrupted, -1 otherwise.

**See also**

`spi_disable_interrupts_globally`

**2.15.3.17 *spi\_uninit***

```
int8_t spi_uninit ( ft900_spi_regs_t * dev )
```

Disable the SPI device.

**Parameters**

**dev**            The device to use

**Returns**

0 on a success or -1 for a failure.

## 2.16 CANBus

The file **ft900\_can.h** contains the definitions for the CANBus functions in the libft900.a library.

### 2.16.1 API Cross Reference

Additional definitions are taken from:

**ft900\_registers.h** – FT90X register definitions

### 2.16.2 Enumeration Type Documentation

#### 2.16.2.1 *can\_mode\_t*

enum can\_mode\_t

The mode of the CAN device.

Enumerator	
can_mode_normal	The CAN Device is operating normally
can_mode_listen	The CAN Device is in listen-only mode and will not allow data transmission or send ACKs on the bus

#### 2.16.2.2 *can\_type\_t*

enum can\_type\_t

CAN message type.

Enumerator	
can_type_standard	CAN2.0A Standard Frame
can_type_extended	CAN2.0B Extended Frame

#### 2.16.2.3 *can\_filter\_mode\_t*

enum can\_filter\_mode\_t

The mode of the filter.

Enumerator	
can_filter_mode_single	Single Filter mode
can_filter_mode_dual	Dual Filter mode

#### 2.16.2.4 *can\_arbitration\_lost\_t*

enum can\_arbitration\_lost\_t

The location of where arbitration was lost.

Enumerator	
can_arbitration_lost_id28_11	Arbitration was lost on the 12th bit of the ID (29th bit extended)
can_arbitration_lost_id27_10	Arbitration was lost on the 11th bit of the ID (28th bit extended)
can_arbitration_lost_id26_9	Arbitration was lost on the 10th bit of the ID (27th bit extended)
can_arbitration_lost_id25_8	Arbitration was lost on the 9th bit of the ID (26th bit extended)



can_arbitration_lost_id24_7	Arbitration was lost on the 8th bit of the ID (25th bit extended)
can_arbitration_lost_id23_6	Arbitration was lost on the 7th bit of the ID (24th bit extended)
can_arbitration_lost_id22_5	Arbitration was lost on the 6th bit of the ID (23rd bit extended)
can_arbitration_lost_id21_4	Arbitration was lost on the 5th bit of the ID (22nd bit extended)
can_arbitration_lost_id20_3	Arbitration was lost on the 4th bit of the ID (21st bit extended)
can_arbitration_lost_id19_2	Arbitration was lost on the 3rd bit of the ID (20th bit extended)
can_arbitration_lost_id18_1	Arbitration was lost on the 2nd bit of the ID (19th bit extended)
can_arbitration_lost_id17_0	Arbitration was lost on the 1st bit of the ID (18th bit extended)
can_arbitration_lost_srtr_rtr	Arbitration was lost on the SRTR/RTR bit
can_arbitration_lost_id16	Arbitration was lost on the 17th bit of the extended ID
can_arbitration_lost_id15	Arbitration was lost on the 16th bit of the extended ID
can_arbitration_lost_id14	Arbitration was lost on the 15th bit of the extended ID
can_arbitration_lost_id13	Arbitration was lost on the 14th bit of the extended ID
can_arbitration_lost_id12	Arbitration was lost on the 13th bit of the extended ID
can_arbitration_lost_id11	Arbitration was lost on the 12th bit of the extended ID
can_arbitration_lost_id10	Arbitration was lost on the 11th bit of the extended ID
can_arbitration_lost_id9	Arbitration was lost on the 10th bit of the extended ID
can_arbitration_lost_id8	Arbitration was lost on the 9th bit of the extended ID
can_arbitration_lost_id7	Arbitration was lost on the 8th bit of the extended ID
can_arbitration_lost_id6	Arbitration was lost on the 7th bit of the extended ID
can_arbitration_lost_id5	Arbitration was lost on the 6th bit of the extended ID
can_arbitration_lost_id4	Arbitration was lost on the 5th bit of the extended ID
can_arbitration_lost_id3	Arbitration was lost on the 4th bit of the extended ID
can_arbitration_lost_id2	Arbitration was lost on the 3rd bit of the extended ID
can_arbitration_lost_id1	Arbitration was lost on the 2nd bit of the extended ID
can_arbitration_lost_id0	Arbitration was lost on the 1st bit of the extended ID
can_arbitration_lost_rtr	Arbitration was lost on the RTR bit
can_arbitration_lost_invalid	No valid arbitration could be found

### 2.16.2.5 can\_interrupt\_t

enum can\_interrupt\_t

CAN Peripheral Interrupts.

Enumerator	
can_interrupt_data_overrun	
can_interrupt_bus_error	
can_interrupt_transmit	
can_interrupt_receive	
can_interrupt_error_passive	
can_interrupt_error_warning	

can_interrupt_arbitration_lost	This enum is for FT90X Revision C onwards only.
can_interrupt_data_overload	

### 2.16.2.6 *can\_rtr\_t*

enum can\_rtr\_t

Remote transfer request flag.

Enumerator	
can_rtr_none	No RTR
can_rtr_remote_request	RTR Set

## 2.16.3 Function Documentation

### 2.16.3.1 *can\_init*

```
int8_t can_init ( ft900_can_regs_t * dev,
                 can_mode_t mode,
                 const can_time_config_t * timeconfig
                )
```

Initialise the CAN device.

#### Parameters

- dev** A pointer to the device to use
- mode** The mode that this CAN device should be in (normal or listen)
- timeconfig** The configuration struct that defines the timing of the device

#### Returns

0 on a success, -1 otherwise.

### 2.16.3.2 *can\_open*

```
int8_t can_open ( ft900_can_regs_t * dev )
```

Open the CAN device for reading and writing.

#### Parameters

- dev** A pointer to the device to use

#### Returns

0 on a success, -1 otherwise.

### 2.16.3.3 *can\_close*

```
int8_t can_close ( ft900_can_regs_t * dev )
```

Close the CAN device for reading and writing.

#### Parameters

- dev** A pointer to the device to use

## Returns

0 on a success, -1 otherwise.

### 2.16.3.4 *can\_filter*

```
int8_t can_filter ( ft900_can_regs_t * dev,
                  can_filter_mode_t  filtmode,
                  uint8_t             filternum,
                  const can_filter_t * filter
                )
```

Set up a filter for the CAN device.

Set up the CAN device to filter for specific criteria.

The filter can work in two modes: single or dual. Depending on which mode the filter is in, certain types of information can be used, as shown in the table below.

Mode	Message Type	ID	RTR	Data[0]	Data[1]
Single	Standard	Yes	Yes	Yes	Yes
Single	Extended	Yes	Yes	No	No
Dual	Standard	Yes	Yes	Filter 0 Only	No
Dual	Extended	Only bits 13 to 28	No	No	No

Any field which is not used in a certain configuration will be ignored.

## Parameters

<b>dev</b>	A pointer to the device to use
<b>filtmode</b>	The mode that the filters should be in (single or dual)
<b>filternum</b>	The number of filter to use. When in single mode, only 0 will work.
<b>filter</b>	A pointer to the configuration to use

## Returns

0 on a success, -1 otherwise.

## Warning

This command only works when the CAN device is closed.

## See also

`can_filter_t`

### 2.16.3.5 *can\_read*

```
int8_t can_read ( ft900_can_regs_t * dev,
                 can_msg_t *         msg
               )
```

Receive a message from the CAN Bus.

This function will take the first available message from the Receive FIFO.

**Parameters**

- dev** A pointer to the device to use
- msg** The struct to pack the message into

**Returns**

0 on a success, -1 otherwise.

**Warning**

This command only works when the CAN device is open.

This function will automatically clear the Receive interrupt flag and increment the Receive message counter.

**2.16.3.6 can\_write**

```
int8_t can_write ( ft900_can_regs_t * dev,  
                  const can_msg_t * msg  
                  )
```

Send a message on the CAN Bus.

This function will accept a can\_msg\_t and pack it into a format to be fed into the CAN Transmit FIFO.

**Parameters**

- dev** A pointer to the device to use
- msg** The message to send

**Returns**

0 on a success, -1 otherwise.

**Warning**

This command only works when the CAN device is open.

**2.16.3.7 can\_abort**

```
int8_t can_abort ( ft900_can_regs_t * dev )
```

Abort the transmission of messages on the CAN Bus.

This function will cause the CAN device to abort transmission on the CAN Bus. After the transmission of the current message on the Bus, no further transmissions will occur (including retransmissions for erroneous messages).

**Parameters**

- dev** A pointer to the device to use

**Returns**

0 on a success, -1 otherwise.

**2.16.3.8 can\_status**

```
uint8_t can_status ( ft900_can_regs_t * dev )
```

Query the status register.

The return value is a bit-mask with the following format:

Bit	Name	Description	Set when...
7 (MSB)	RX_BUF_STS	Receive Buffer Status	At least one message in the receive FIFO
6	OVRN_STS	Data Overrun Status	The receive FIFO has encountered an overrun
5	TX_BUF_STS	Transmit Buffer Status	The CPU is able to write to the transmit FIFO
4	-		
3	RX_STS	Receive Status	CAN is currently receiving a message
2	TX_STS	Transmit Status	CAN is currently transmitting a message
1	ERR_STS	Error Status	One CAN error counter has reached warning (96)
0 (LSB)	BUS_OFF_STS	Bus Off Status	The CAN device is in a bus off state

### Parameters

**dev** A pointer to the device to use

### Returns

A bit-mask of the current status or 0 for an unknown device.

#### 2.16.3.9 *can\_available*

```
uint8_t can_available ( ft900_can_regs_t * dev )
```

Return how many messages are available in the receive FIFO.

### Parameters

**dev** A pointer to the device to use

### Returns

The number of messages available in the receive FIFO.

#### 2.16.3.10 *can\_rx\_error\_count*

```
uint8_t can_rx_error_count ( ft900_can_regs_t * dev )
```

Get the current number of receive errors reported by the CAN device.

### Parameters

**dev** A pointer to the device to use

### Returns

The current number of receive errors (0 - 255) or 0 for an unknown device.

#### 2.16.3.11 *can\_tx\_error\_count*

```
uint8_t can_tx_error_count ( ft900_can_regs_t * dev )
```

Get the current number of transmit errors reported by the CAN device.

When the transmit error counter exceeds limit of 255, the Bus Status bit in the Status register is set to logic 1 (bus off), the CAN controller set reset mode, and if enabled, an error warning interrupt is generated. The transmit error counter is then set to 127 and receive error counter is cleared.

## Parameters

**dev** A pointer to the device to use

## Returns

The current number of receive errors (0 - 255) or 0 for an unknown device.

### 2.16.3.12 *can\_ecode*

```
uint8_t can_ecode ( ft900_can_regs_t * dev )
```

Get the current value of the ECC (Error Code Capture) register.

This function will return the value of the ECC (Error Code Capture) register. This register holds the error code for the *LAST* bus error that occurred on the CAN network.

The return value is a bit-mask with the following format:

Bit	Name	Description	Set when...
7 (MSB)	RX_WRN	Receive Warning	The number of receive errors is $\geq 96$
6	TX_WRN	Transmit Warning	The number of transmit errors is $\geq 96$
5	ERR_DIR	Direction	The error occurred on reception.
4	ACK_ERR	Acknowledgement Error	An ACK Error occurred
3	FRM_ERR	Form Error	A Form Error occurred
2	CRC_ERR	CRC Error	A CRC Error occurred
1	STF_ERR	Stuff Error	A Bit Stuffing Error occurred
0 (LSB)	BIT_ERR	Bit Error	A Bit Error occurred

## Parameters

**dev** A pointer to the device to use

## Returns

The value of the ECC (Error Code Capture) register or 0 for an unknown device.

### 2.16.3.13 *can\_arbitration\_lost\_location*

```
can_arbitration_lost_t can_arbitration_lost_location ( ft900_can_regs_t * dev )
```

Get the location where arbitration was lost.

## Parameters

**dev** A pointer to the device to use

## Returns

The location where arbitration was lost.

### 2.16.3.14 *can\_enable\_interrupt*

```
int8_t can_enable_interrupt ( ft900_can_regs_t * dev,
                             can_interrupt_t   interrupt
                             )
```

Enable an Interrupt.

Enable the CAN device to generate an interrupt. The value of mask is a bit-mask with the following format:

Bit	Name	Description	Trigger
7 (MSB)		Unused	
6	ARB_LOST	Arbitration Lost Interrupt	Arbitration is lost
5	ERR_WARN	Error Warning Interrupt	Changes in ES or BS of the Status register
4	ERR_PSV	Error Passive Interrupt	Bus enters or exits a passive state
3	RX	Receive Interrupt	A message is received on CAN
2	TX	Transmit Interrupt	A message is successfully received on CAN
1	BUS_ERR	Bus Error Interrupt	A bus error occurred when transmitting/receiving
0 (LSB)	DATA_OVRN	Data Overrun Interrupt	A receive FIFO overrun occurred

#### Parameters

**dev** A pointer to the device to use

**interrupt** The interrupt to enable

#### Returns

0 on a success, -1 otherwise.

#### Warning

This command only works when the CAN device is closed.

#### 2.16.3.15 *can\_disable\_interrupt*

```
int8_t can_disable_interrupt ( ft900_can_regs_t * dev,
                             can_interrupt_t   interrupt
                             )
```

Disable an Interrupt.

Disable the CAN device from generating an interrupt.

#### Parameters

**dev** A pointer to the device to use

**interrupt** The interrupt to disable

#### Returns

0 on a success, -1 otherwise.

#### Warning

This command only works when the CAN device is closed.

#### 2.16.3.16 *can\_is\_interrupted*

```
int8_t can_is_interrupted ( ft900_can_regs_t * dev,
                           can_interrupt_t   interrupt
                           )
```

Query the Interrupt register.

Query the Interrupt register in order to determine what caused the interrupt.

#### Parameters

**dev** A pointer to the device to use

**interrupt** The interrupt to check

#### Warning

This function clears the interrupt bit so that it does not fire constantly.

#### Returns

0 when the interrupt hasn't been fired, 1 when the interrupt has fired and -1 otherwise.

### 2.16.4 Variable Documentation

`const can_time_config_t g_can125kbaud`

Configuration for 125 kBaud at fcpu = 100 MHz

`const can_time_config_t g_can1Mbaud`

Configuration for 1 MBaud at fcpu = 100 MHz

`const can_time_config_t g_can250kbaud`

Configuration for 250 kBaud at fcpu = 100 MHz

`const can_time_config_t g_can500kbaud`

Configuration for 500 kBaud at fcpu = 100 MHz

## 2.17 Camera interface

The file **ft900\_cam.h** contains the definitions for the camera bus functions in the libft900.a library.

### 2.17.1 API Cross Reference

It utilises the following library APIs:

**ft900\_asm.h** – FT90X assembler definitions

Additional definitions are taken from:

**ft900\_registers.h** – FT90X register definitions

### 2.17.2 Enumeration Type Documentation

#### 2.17.2.1 *cam\_clock\_pol\_t*

enum **cam\_clock\_pol\_t**

Camera clock polarity.

Enumerator	
<code>cam_clock_pol_falling</code>	Sample data on a falling PCLK edge
<code>cam_clock_pol_raising</code>	Sample data on a raising PCLK edge



### 2.17.2.2 *cam\_trigger\_mode\_t*

enum **cam\_trigger\_mode\_t**

Camera vertical/horizontal trigger mode Control at what logic levels the camera will accept data.

Enumerator	
cam_trigger_mode_0	VD = L, HD = L
cam_trigger_mode_1	VD = L, HD = H
cam_trigger_mode_2	VD = H, HD = L
cam_trigger_mode_3	VD = H, HD = H

## 2.17.3 Function Documentation

### 2.17.3.1 *cam\_init*

```
int8_t cam_init ( cam_trigger_mode_t triggers,
                  cam_clock_pol_t   clkpol
                )
```

Initialise the Camera interface.

#### Parameters

**triggers**     The VD/HD levels to trigger on  
**clkpol**        The clock polarity of the input

#### Returns

0 on success, -1 otherwise.

### 2.17.3.2 *cam\_available*

```
uint16_t cam_available ( void )
```

Check how many bytes are available on the FIFO.

#### Returns

The number of bytes available.

### 2.17.3.3 *cam\_start*

```
int8_t cam_start ( uint16_t bytes )
```

Start capturing data.

#### Parameters

**bytes**        The number of bytes to capture

#### Returns

0 on success, -1 otherwise.

### 2.17.3.4 *cam\_stop*

```
int8_t cam_stop ( void )
```

Stop capturing data.

**Returns**

0 on success, -1 otherwise.

**2.17.3.5 *cam\_set\_threshold***

```
int8_t cam_set_threshold ( uint16_t n )
```

Set the threshold for when the camera interrupt fires.

**Parameters**

**n** The number of bytes to fill the FIFO with before the interrupt fires.  
(This must be a multiple of 4).

**Returns**

0 on success, -1 otherwise.

**2.17.3.6 *cam\_readn***

```
uint16_t cam_readn ( uint8_t * b,  
                    size_t len  
                    )
```

Read a number of bytes from the FIFO.

**Parameters**

**b** A pointer to read the data into  
**len** The number of bytes to read from the FIFO (this must be a multiple of 4)

**Returns**

The number of bytes read, 0 otherwise.

**2.17.3.7 *cam\_flush***

```
void cam_flush ( void )
```

Empty out the camera buffer.

**2.17.3.8 *cam\_total\_read***

```
uint16_t cam_total_read ( void )
```

Check how many bytes have been read by the Camera Interface.

**Returns**

The number of bytes read.

**2.17.3.9 *cam\_enable\_interrupt***

```
int8_t cam_enable_interrupt ( void )
```

Enable the threshold interrupt.

**Returns**

0 on success, -1 otherwise.

### 2.17.3.10 *cam\_disable\_interrupt*

```
int8_t cam_disable_interrupt ( void )
```

Disable the threshold interrupt.

#### Returns

0 on success, -1 otherwise.

### 2.17.3.11 *cam\_is\_interrupted*

```
int8_t cam_is_interrupted ( void )
```

Check that an interrupt has occurred.

#### Returns

0 when the interrupt hasn't been fired, 1 when the interrupt has fired and -1 otherwise.

## 2.18 Pulse Width Modulation

The file **ft900\_pwm.h** contains the definitions for the Pulse Width Modulation functions in the libft900.a library.

### 2.18.1 API Cross Reference

Additional definitions are taken from:

**ft900\_registers.h** – FT90X and FT93X register definitions

### 2.18.2 Enumeration Type Documentation

#### 2.18.2.1 *pwm\_restore\_t*

```
enum pwm_restore_t
```

PWM restore state.

Enumerator	
pwm_restore_disable	Do not restore the setup state on wrap around
pwm_restore_enable	Do not restore the setup state on wrap around

#### 2.18.2.2 *pwm\_state\_t*

```
enum pwm_state_t
```

Enumerator	
pwm_state_low	Setup as low
pwm_state_high	Setup as high

#### 2.18.2.3 *pwm\_trigger\_t*

```
enum pwm_trigger_t
```

PWM Triggering.

Enumerator	
pwm_trigger_disabled	Do not trigger
pwm_trigger_positive_edge	Trigger on a positive edge
pwm_trigger_negative_edge	Trigger on a negative edge
pwm_trigger_any_edge	Trigger on any edge

### 2.18.3 Function Documentation

#### 2.18.3.1 *pwm\_init*

```
int8_t pwm_init ( uint8_t  prescaler,
                  uint16_t maxcount,
                  uint8_t  shots
                  )
```

Initialise the PWM subsystem.

##### Parameters

**prescaler**      The prescaler for the PWM subsystem

**maxcount**      The maximum count of the 16-bit master counter

**shots**          The number of loops the PWM subsystem will make, 0 is infinity

##### Returns

On success a 0, otherwise -1.

#### 2.18.3.2 *pwm\_enable*

```
int8_t pwm_enable ( void  )
```

Enable the PWM subsystem.

##### Returns

On success a 0, otherwise -1.

#### 2.18.3.3 *pwm\_disable*

```
int8_t pwm_disable ( void  )
```

Disable the PWM subsystem.

##### Returns

On success a 0, otherwise -1.

#### 2.18.3.4 *pwm\_add\_toggle*

```
int8_t pwm_add_toggle ( uint8_t  channel,
                        uint8_t  toggle
                        )
```

Add a toggle to a specific PWM channel.

**Parameters**

**channel**      The channel to add the toggle to  
**toggle**      The channel to toggle on

**Returns**

On success a 0, otherwise -1.

**2.18.3.5 *pwm\_remove\_toggle***

```
int8_t pwm_remove_toggle ( uint8_t channel,  
                           uint8_t toggle  
                           )
```

Remove a toggle to a specific PWM channel.

**Parameters**

**channel**      The channel to remove the toggle from  
**toggle**      The channel to remove the toggle of

**Returns**

On success a 0, otherwise -1.

**2.18.3.6 *pwm\_compare***

```
int8_t pwm_compare ( uint8_t channel,  
                    uint16_t value  
                    )
```

Set a compare value for a PWM counter.

**Parameters**

**channel**      The channel to use  
**value**      The value to toggle on

**Returns**

On success a 0, otherwise -1.

**2.18.3.7 *pwm\_levels***

```
int8_t pwm_levels ( uint8_t channel,  
                   pwm_state_t initstate,  
                   pwm_restore_t restorestate  
                   )
```

Set up the logic levels for a PWM counter.

**Parameters**

**channel**      The channel to use  
**initstate**    The initial state of the counter (high or low)

**restorestate** The rollover restore setting

#### Returns

On success a 0, otherwise -1.

#### 2.18.3.8 *pwm\_trigger*

```
int8_t pwm_trigger ( pwm_trigger_t trigger )
```

Set the external trigger settings.

#### Parameters

**trigger** The trigger setting

#### Returns

On success a 0, otherwise -1.

## 2.19 PWM Audio

The file **ft900\_pwm\_pcm.h** contains the definitions for the PWM audio functions in the libft900.a library.

#### 2.19.1 API Cross Reference

It utilises the following library APIs:

**ft900\_pwm.h** – Pulse Width Modulation

**ft900\_asm.h** – FT90X and FT93X assembler definitions

Additional definitions are taken from:

**ft900\_registers.h** – FT90X and FT93X register definitions

#### 2.19.2 Enumeration Type Documentation

##### 2.19.2.1 *pwm\_pcm\_channels\_t*

```
enum pwm_pcm_channels_t
```

PWM Channel selection.

Enumerator	
pwm_pcm_channels_mono	Mono
pwm_pcm_channels_stereo	Stereo

##### 2.19.2.2 *pwm\_pcm\_data\_size\_t*

```
enum pwm_pcm_data_size_t
```

PWM data size selection.

Enumerator	
pwm_pcm_data_size_8	8 bit
pwm_pcm_data_size_16	16 bit

### 2.19.2.3 *pwm\_pcm\_endianness\_t*

enum pwm\_pcm\_endianness\_t

PWM endianness selection.

Enumerator	
pwm_pcm_endianness_big	Big endian data
pwm_pcm_endianness_little	Little endian data

### 2.19.2.4 *pwm\_pcm\_filter\_t*

enum pwm\_pcm\_filter\_t

PWM PCM Filter.

Enumerator	
pwm_pcm_filter_off	Off
pwm_pcm_filter_on	On

### 2.19.2.5 *pwm\_pcm\_interrupt\_t*

enum pwm\_pcm\_interrupt\_t

PWM PCM Interrupt selection.

Enumerator	
pwm_pcm_interrupt_empty	FIFO Empty
pwm_pcm_interrupt_full	FIFO Full
pwm_pcm_interrupt_half_full	FIFO Half Full
pwm_pcm_interrupt_overflow	FIFO Overflow
pwm_pcm_interrupt_underflow	FIFO Underflow

### 2.19.2.6 *pwm\_pcm\_volume\_t*

enum pwm\_pcm\_volume\_t

PWM PCM Volume.

Enumerator	
pwm_pcm_volume_mute	
pwm_pcm_volume_6	6.25% volume
pwm_pcm_volume_12	12.5% volume
pwm_pcm_volume_19	19% volume
pwm_pcm_volume_25	25% volume
pwm_pcm_volume_31	31% volume
pwm_pcm_volume_37	37% volume
pwm_pcm_volume_44	44% volume
pwm_pcm_volume_50	50% volume

pwm_pcm_volume_56	56% volume
pwm_pcm_volume_63	63% volume
pwm_pcm_volume_69	69% volume
pwm_pcm_volume_75	75% volume
pwm_pcm_volume_81	81% volume
pwm_pcm_volume_88	88% volume
pwm_pcm_volume_94	94% volume
pwm_pcm_volume_100	100% volume

### 2.19.3 Function Documentation

#### 2.19.3.1 *pwm\_pcm\_open*

```
int8_t pwm_pcm_open ( pwm_pcm_channels_t  channels,
                      uint16_t            samplerate,
                      pwm_pcm_data_size_t  datasize,
                      pwm_pcm_endianness_t endianness,
                      pwm_pcm_filter_t     filter
                      )
```

Initialise the PWM PCM output.

##### Parameters

<b>channels</b>	The number of channels to output.
<b>samplerate</b>	The sample rate of the audio data.
<b>datasize</b>	The word size of the samples (8 or 16 bit).
<b>endianness</b>	The endianness of the 16-bit word. In 8-bit mode this will be ignored.
<b>filter</b>	If a PCM filter will be used to filter out the PWM carrier.

##### Returns

On success a 0, otherwise -1.

#### 2.19.3.2 *pwm\_pcm\_close*

```
int8_t pwm_pcm_close ( void )
```

Close the PWM PCM Output.

##### Returns

On success a 0, otherwise -1.

#### 2.19.3.3 *pwm\_pcm\_volume*

```
int8_t pwm_pcm_volume ( pwm_pcm_volume_t vol )
```

Set the volume of the PWM PCM device.



**Parameters**

**vol** The volume to set to.

**Returns**

On success a 0, otherwise -1.

**2.19.3.4 *pwm\_pcm\_write***

```
int8_t pwm_pcm_write ( uint16_t data )
```

Write a word of data to the PWM PCM device.

**Parameters**

**data** The data to write. If 8-bit mode is selected, the top 8 bits will be ignored.

**Returns**

The number of bytes written to the FIFO, otherwise -1.

**2.19.3.5 *pwm\_pcm\_writen***

```
int8_t pwm_pcm_writen ( uint16_t * data,  
                        size_t len  
                        )
```

Write a number of words of data to the PWM PCM device.

**Parameters**

**data** The data to write. If 8-bit mode is selected, the top 8 bits will be ignored.

**len** The size of data to write.

**Returns**

The number of bytes written to the FIFO, otherwise -1.

**2.19.3.6 *pwm\_pcm\_disable\_interrupt***

```
int8_t pwm_pcm_disable_interrupt ( pwm_pcm_interrupt_t interrupt )
```

Disable an interrupt.

**Parameters**

**interrupt** The interrupt to disable.

**Returns**

On success a 0, otherwise -1.

**2.19.3.7 *pwm\_pcm\_enable\_interrupt***

```
int8_t pwm_pcm_enable_interrupt ( pwm_pcm_interrupt_t interrupt )
```

Enable an interrupt.

**Parameters**

**interrupt** The interrupt to enable

## Returns

On success a 0, otherwise -1.

### 2.19.3.8 *pwm\_pcm\_is\_interrupted*

```
int8_t pwm_pcm_is_interrupted ( pwm_pcm_interrupt_t interrupt )
```

Query if an interrupt has fired.

## Parameters

**interrupt**     The interrupt to query

## Warning

This function will clear the interrupt being queried and the global PWM interrupt flag.

## Returns

1 if PWM is interrupted, 0 if PWM is not interrupted, -1 otherwise.

## 2.20 Real Time Clock

The file **ft900\_rtc.h** contains the definitions for the real time clock functions in the libft900.a and libft930.a library. The RTC API is meant for the on-chip RTC on FT90X Revision C and FT93X which are the same. However, the RTC API is also made backward compatible with FT90X Revision B, where the RTC hardware block is different from that of FT93X/FT90X Rev C. The definitions below indicate wherever there is a difference for FT90X Revision B.

### 2.20.1 API Cross Reference

Additional definitions are taken from:

**ft900\_registers.h** – FT90X and FT93X register definitions

**time.h** – C library time.h, used to access **struct tm**

### 2.20.2 Enumeration Type Documentation

#### 2.20.2.1 *rtc\_interrupt\_t*

```
enum rtc_interrupt_t
```

RTC Interrupts

Enumerator	
rtc_interrupt_alarm1	Alarm 1 Interrupt
rtc_interrupt_alarm2	Alarm 2 Interrupt
rtc_interrupt_ext_osc_stopped	External Oscillator Stopped Interrupt
rtc_interrupt_int_osc_stopped	Internal Oscillator Stopped Interrupt
rtc_interrupt_int_auto_calibration	Auto Calibration Interrupt
rtc_interrupt_max	Placeholder for maximum value
rtc_legacy_interrupt_alarm	This ENUM is ONLY applicable to FT90x Revision B on-chip RTC and is the only enum to be used.

#### 2.20.2.2 *rtc\_alarm\_type\_t*

```
enum rtc_alarm_type_t
```

RTC Alarm Types

Enumerator	
rtc_alarm_1Hz	Alarm every second
rtc_alarm_match_sec	Alarm when seconds match
rtc_alarm_match_min_sec	Alarm when seconds and minutes match
rtc_alarm_match_hr_min_sec	Alarm when seconds, minutes and hours match
rtc_alarm_match_date_hr_min_sec	Alarm when seconds, minutes, hours and date matches
rtc_alarm_match_day_hr_min_sec	Alarm when seconds, minutes, hours and day matches
rtc_legacy_alarm	This ENUM is ONLY applicable to FT90X Revision B on-chip RTC and time's is the only enum to be used.

### 2.20.2.3 *rtc\_option\_t*

enum rtc\_option\_t

RTC Option

Enumerator	
rtc_option_auto_refresh	Auto Refresh Option
rtc_option_wrap	Enable or disable RTC Wrap around (Applicable ONLY in FT900 Revision B)
rtc_option_mask_interrupt	Option to set whether the Real Time Clock module should mask the match interrupt line (Applicable ONLY in FT90X Revision B)

## 2.20.3 Function Documentation

### 2.20.3.1 *rtc\_init*

int8\_t rtc\_init ( void )

Initialise the Real Time Clock.

#### Returns

0 on success, -1 otherwise.

### 2.20.3.2 *rtc\_start*

int8\_t rtc\_start ( void )

Start the Real Time Clock.

#### Returns

0 on success, -1 otherwise.

### 2.20.3.3 *rtc\_stop*

int8\_t rtc\_stop ( void )

Stop the Real Time Clock.

#### Returns

0 on success, -1 otherwise.

#### **2.20.3.4 rtc\_read**

int8\_t rtc\_read ( struct tm\* const time )

Read the current value of the Real Time Clock.

##### **Parameters**

**time** A pointer of type **struct tm\*** (defined in <time.h>) to which the RTC time is to be read in case of FT93X and FT90X rev C. Only the field **tm.sec** is written to with current RTC time read, in case of FT90X rev B.

##### **Returns**

0 on success, -1 otherwise.

#### **2.20.3.5 rtc\_write**

int8\_t rtc\_write ( const struct tm\* time )

Write the given date/time to the Real Time Clock.

##### **Parameters**

**time** A pointer of type **struct tm\*** (defined in <time.h>) contains the time to be written into the RTC for FT93X and FT90X rev C. Only the field **tm.sec** should contain the RTC time to be written in case of FT90X rev B.

##### **Returns**

0 on success, -1 otherwise.

#### **2.20.3.6 rtc\_option**

int8\_t rtc\_option ( rtc\_option\_t opt, uint8\_t val )

Control options of the RTC.

##### **Parameters**

**opt** The type of option to update

**val** The value of the selected option

##### **Returns**

0 on success, -1 otherwise.

#### **2.20.3.7 rtc\_set\_alarm**

```
int8_t rtc_set_alarm ( uint8_t      number,  
                      struct tm*   time,  
                      rtc_alarm_type alarm_type  
                      )
```

Set an Alarm on the RTC.

##### **Parameters**

**number** The number of the Alarm to set (1 or 2)

**time** The date/time of the Alarm

**alarm\_type** The type of alarm match required

**Returns**

0 on success, -1 otherwise.

**2.20.3.8 *rtc\_is\_interrupted***

```
int8_t rtc_is_interrupted ( rtc_interrupt_t Interrupt)
```

Check if an interrupt has been triggered.

**Parameters**

**interrupt** The interrupt to check

**Warning**

This function clears the current interrupt status bit.

**Returns**

1 when interrupted, 0 when not interrupted, -1 otherwise.

**2.20.3.9 *rtc\_enable\_interrupt***

```
int8_t rtc_enable_interrupt ( rtc_interrupt_t Interrupt)
```

Enable an interrupt on the RTC.

**Parameters**

**interrupt** The interrupt to enable

**Returns**

0 on success, -1 otherwise.

**2.20.3.10 *rtc\_enable\_interrupts\_globally***

```
int8_t rtc_enable_interrupts_globally ( void )
```

Enable RTC interrupts.

**Returns**

0 on success, -1 otherwise.

**2.20.3.11 *rtc\_disable\_interrupt***

```
int8_t rtc_disable_interrupt ( rtc_interrupt_t Interrupt)
```

Disable an interrupt on the RTC.

**Parameters**

**interrupt** The interrupt to disable

**Returns**

0 on success, -1 otherwise.

**2.20.3.12 *rtc\_disable\_interrupts\_globally***

```
int8_t rtc_disable_interrupts_globally ( void )
```

Disable the RTC from interrupting.

## Returns

0 on success, -1 otherwise.

## 2.21 USB Device Stack API

The file **ft900\_usbd.h** contains the definitions for the USB device functions in the libft900.a and libft930.a library. The extended API for asynchronous operation is in the file **ft900\_usbdx.h**.

The document "BRT\_AN\_089 FT9xx USB Device Extended API" describes fully the operation of the extended API. Functions, typedefs, structures and macros beginning with **USBDX** are part of the extended API, those beginning with **USBD** are part of the standard API. The standard API can be used without reference to the extended API.

This contains USB Device API function definitions, constants and structures which are exposed in the API.

Note that as this is a USB device, all transaction nomenclature is from the point of view from the host. If the device sends data to the host, then it is called an IN transaction. If it receives data from the host, then it is an OUT transaction.

### 2.21.1 API Cross Reference

Utilises the following library APIs:

**ft900\_gpio.h** – General Purpose I/O and Pad Control

**ft900\_sys.h** – Chip Management

**ft900\_delay.h** – Delay

**ft900\_interrupt.h** – Interrupt Management

Additional definitions are taken from:

**ft900\_usb.h** – General USB definitions

**ft900\_registers.h** – FT90X and FT93X register definitions

### 2.21.2 Macro Definition Documentation

#### 2.21.2.1 USB Device Error Codes

#define USBD\_ERR\_DISCONNECTED -10

Device not configured by host.

Device physically disconnected from host.

#define USBD\_ERR\_INCOMPLETE -5

Incomplete/interrupted transfer.

#define USBD\_ERR\_RESOURCES -4

Not enough endpoint resources.

#define USBD\_ERR\_NOT\_SUPPORTED -3

Operation not supported.

#define USBD\_ERR\_NOT\_CONFIGURED -2

Endpoint not configured.

#define USBD\_ERR\_INVALID\_PARAMETER -1

Invalid parameter supplied to API function.

### 2.21.3 Typedef Documentation

#### 2.21.3.1 *USBD\_reset\_callback*

```
typedef void(* USBD_reset_callback) (uint8_t status)
```

Callback declaration for a host reset.

##### Parameters

[in] **status** Unused.

#### 2.21.3.2 *USBD\_suspend\_callback*

```
typedef void(* USBD_suspend_callback) (uint8_t status)
```

Callback declaration for a suspend/resume.

##### Parameters

[in] **status** Unused.

#### 2.21.3.3 *USBD\_request\_callback*

```
typedef int8_t(* USBD_request_callback) (USB_device_request *req)
```

Callback declaration for Vendor, Class and optionally Standard USB requests.

##### Parameters

[in] **req** USB request.

##### Returns

USBD\_OK if the request was handled successfully; any other return value (such as FT9XX\_FAILED) causes the USB driver to stall the control endpoints.

#### 2.21.3.4 *USBD\_descriptor\_callback*

```
typedef int8_t(* USBD_descriptor_callback) (USB_device_request *req, uint8_t **buffer, uint16_t *len)
```

Callback declaration for standard get descriptor requests to obtain descriptor data.

##### Parameters

[in] **req** USB request.

[in] **buffer** Data buffer containing descriptor.

##### Returns

USBD\_OK if the request was handled successfully; any other return value (such as FT9XX\_FAILED) causes the USB driver to stall the control endpoints.

#### 2.21.3.5 *USBD\_ep\_callback*

```
typedef void(* USBD_ep_callback) (USBD_ENDPOINT_NUMBER ep_number)
```

Callback declaration for transaction completion on endpoint. The endpoint number is passed to the callback to allow the same function to handle multiple endpoints.

### 2.21.3.6 USBDX\_callback

```
typedef bool(* USBDX_callback) (struct USBDX_pipe *pp)
```

Callback function declaration for all extended API functions.

### 2.21.4 Enumeration Type Documentation

#### 2.21.4.1 USBD\_STATE

```
enum USBD_STATE
```

USB States. USB Spec section 9.1.

Enumerator	
USBD_STATE_NONE	Device is not attached.
USBD_STATE_ATTACHED	Device is attached to USB.
USBD_STATE_POWERED	Device is attached and powered.
USBD_STATE_DEFAULT	Device is attached, has power and has been reset.
USBD_STATE_ADDRESS	Unique device address has not been set.
USBD_STATE_CONFIGURED	Unique device address is now assigned. Device can be used by host.
USBD_STATE_SUSPENDED	Device has been suspended.

#### 2.21.4.2 USBD\_DEVICE\_SPEED

```
enum USBD_DEVICE_SPEED
```

USB Endpoint Speed setting.

Enumerator	
USBD_SPEED_FULL	Full speed.
USBD_SPEED_HIGH	High speed.

#### 2.21.4.3 USBD\_ENDPOINT\_NUMBER

```
enum USBD_ENDPOINT_NUMBER
```

USB Endpoint Numbers.

Enumerator	
USBD_EP_0	Endpoint 0 (Control Endpoint)
USBD_EP_1	Endpoint 1.
USBD_EP_2	Endpoint 2.
USBD_EP_3	Endpoint 3.
USBD_EP_4	Endpoint 4.
USBD_EP_5	Endpoint 5.
USBD_EP_6	Endpoint 6.
USBD_EP_7	Endpoint 7.
USBD_EP_8	Endpoint 8. [FT93X only]



USBD_EP_9	Endpoint 9. [FT93X only]
USBD_EP_10	Endpoint 10. [FT93X only]
USBD_EP_11	Endpoint 11. [FT93X only]
USBD_EP_12	Endpoint 12. [FT93X only]
USBD_EP_13	Endpoint 13. [FT93X only]
USBD_EP_14	Endpoint 14. [FT93X only]
USBD_EP_15	Endpoint 15. [FT93X only]

#### 2.21.4.4 USB\_ENDPOINT\_DIR

enum USBD\_ENDPOINT\_DIR

USB Endpoint Direction.

Enumerator	
USBD_DIR_OUT	Direction host to device.
USBD_DIR_IN	Direction device to host.

#### 2.21.4.5 USB\_ENDPOINT\_SIZE

enum USBD\_ENDPOINT\_SIZE

USB Endpoint Sizes.

Enumerator	
USBD_EP_SIZE_8	8 Bytes
USBD_EP_SIZE_16	16 Bytes
USBD_EP_SIZE_32	32 Bytes
USBD_EP_SIZE_64	64 Bytes
USBD_EP_SIZE_128	128 Bytes. Only available on High-Speed endpoints.
USBD_EP_SIZE_256	256 Bytes. Only available on High-Speed endpoints.
USBD_EP_SIZE_512	512 Bytes. Only available on High-Speed endpoints.
USBD_EP_SIZE_1024	1024 Bytes. Only available on ISO endpoints.

#### 2.21.4.6 USB\_ENDPOINT\_TYPE

enum USBD\_ENDPOINT\_TYPE

USB Endpoint Types.

Enumerator	
USBD_EP_TYPE_DISABLED	Disabled.
USBD_EP_BULK	Bulk Endpoint.
USBD_EP_INT	Interrupt Endpoint.
USBD_EP_ISOC	Isochronous Endpoint.
USBD_EP_CTRL	Control Endpoint.

#### 2.21.4.7 USBD\_ENDPOINT\_DB

enum USBD\_ENDPOINT\_DB

USB Endpoint Double Buffering Enable.

Enumerator	
USBD_DB_OFF	Disabled.
USBD_DB_ON	Enabled.

#### 2.21.5 Structure Documentation

##### 2.21.5.1 USBD\_ctx

Struct containing callback functions for the USB upper layer driver and callback functions for USB suspend/resume and USB reset. Sets USB configuration information.

##### Data Fields

USBD_descriptor_callback	get_descriptor_cb
USBD_set_configuration_callback	set_configuration_cb
USBD_request_callback	standard_req_cb
USBD_set_interface_callback	set_interface_cb
USBD_get_interface_callback	get_interface_cb
USBD_request_callback	class_req_cb
USBD_request_callback	vendor_req_cb
USBD_request_callback	ep_feature_req_cb
USBD_request_callback	feature_req_cb
USBD_suspend_callback	suspend_cb
USBD_suspend_callback	resume_cb
USBD_suspend_callback	lpm_cb
USBD_reset_callback	reset_cb
USBD_suspend_callback	sof_cb
USBD_ENDPOINT_SIZE	ep0_size
USBD_ep_callback	ep0_cb
USBD_DEVICE_SPEED	speed
uint8_t	lowPwrSuspend

##### Field Documentation

class\_req\_cb

[Optional] class request callback function.

ep0\_cb

Callback function for a data transfer to or from the control endpoint.

ep0\_size

Endpoint size for control endpoints. Refer to AN\_324 FT900 User Manual. Sets DC\_EP0\_CONTROL register in Table 9.6 - DC\_EP0\_CONTROL – Endpoint 0 Control Register.  
 0: 8 bytes. 1: 16 bytes. 2: 32 bytes. 3: 64 bytes.

get\_descriptor\_cb

[Optional] Descriptor callback function.

Handler function to obtain descriptors (device, configuration, string, HID, Hub etc.) for use with the built-in USB standard request handler. This must be present if the standard request handler callback is not used.

set\_configuration\_cb

[Optional] Handler function to check set configuration is valid for application. For use with the built-in USB standard request handler. If this is not present, then the default handling of the request will occur.

set\_interface\_cb

[Optional] Handler function to set the alternate settings for an interface. For use with the built-in USB standard request handler. If this is not present, then the request will be stalled.

get\_interface\_cb

[Optional] Handler function to return the alternate settings for an interface. For use with the built-in USB standard request handler. If this is not present, then the request will be stalled.

ep\_feature\_req\_cb

[Optional] Endpoint Feature request callback function.

feature\_req\_cb

[Optional] Device Feature (Remote Wakeup) request callback function.

lowPwrSuspend

Device power control. Engage power saving mode if bus-powered and suspend state entered.  
0: Disable. 1: Enabled.

lpm\_cb

[Optional] USB bus LPM (Link Power Management) callback function.

reset\_cb

[Optional] USB bus reset callback function.

resume\_cb

[Optional] USB bus suspend callback function.

sof\_cb

[Optional] USB SOF callback function.

speed

Device configuration section. High speed/full speed select. The device will only operate in high-speed mode if selected by this option.

0: Full speed only.

1: High speed if available.

standard\_req\_cb

[Optional] Standard request callback function.

Handler for USB standard requests. This is used for overriding the built-in standard request handler to customise the responses to standard requests. If it is not set, then the built-in handler will be used and the descriptor\_cb function used to obtain descriptors.

suspend\_cb

[Optional] USB bus suspend callback function.

vendor\_req\_cb

[Optional] vendor request callback function.

### 2.21.5.2 USBDX\_urb

Struct for USB Request Block or URB USBDX is based on message passing transactions. The messages are called URBs, which stands for USB request block. URBs are sent by calling the USBDX\_submit\_urb method, which is an asynchronous call, and it returns immediately.

#### Data Fields

uint8_t *	start
uint8_t *	ptr
uint8_t *	end
bool	owned_by_usbd
uint8_t	id
struct USBDX_urb *	next

#### Field Documentation

end

OUT: end of data to be transferred; IN: Maximum packet length

id

URB number or id

next

Pointer to next URB

owned\_by\_usbd

Ownership bit

ptr

Reset to &buf[0] after data transfer OUT: start of buffer to be processed IN: end of data to be transferred.

start

Start of URB

### 2.21.5.3 USBDX\_pipe

Struct to maintain the pipe related data. A pipe structure is for each endpoint.

#### Data Fields

struct USBDX_urb *	usbd_urb
struct USBDX_urb *	app_urb
uint8_t *	buf_start
uint8_t *	buf_end
USBDX_callback	on_usbd_ready

USBDX_callback	on_usbd_underrun
uint8_t	id
uint8_t	ep
bool	usbd_paused
bool	app_paused

## Field Documentation

app\_paused

Application pauses itself when no buffer can be processed, and is waiting for USB to give more data. USB engine will call the on\_usbd\_ready callback once app is paused, to resume the application's process.

app\_urb

The address of the start of the URB that is available for application to process.

buf\_end

End of the linear buffer.

buf\_start

Start of the linear buffer.

Ep

USB\_ENDPOINT\_NUMBER with MSB bit set in case of IN endpoint.

Id

USB\_ENDPOINT\_NUMBER for which a pipe has to be created.

on\_usbd\_ready

Application's callback function registered with USB will be called at the event when USB engine is ready.

on\_usbd\_underrun

Application's callback function registered with USB will be called at the event when USB engine is underrunning.

usbd\_paused

Set if USB engine is paused when no application data

usbd\_urb

The address of the start of the URB that is available for USB to process.

## 2.21.6 Function Documentation

### 2.21.6.1 USB Initialise

```
void USB Initialise ( USB_ctx * ctx )
```

Initialise USB hardware.

Performs a software reset and initialises the USB hardware.

The **USB\_ctx** contains function pointers to the protocol layer handling USB requests. Appropriate

USB requests will be routed to the correct handler, whether that is Standard, Class or Vendor requests. A device may not need a handler for Vendor or Class requests depending on the device configuration.

Optional function pointers are also available for USB suspend and resume call-backs and bus resets issued by the host.

This function **MUST** be called prior to any further call to the USB functions.

#### Parameters

[in] **ctx** USB context.

#### **2.21.6.2 USBD\_finalise**

```
void USBD_finalise ( void )
```

Finalise USB hardware.

Releases any resources associated with the USB driver and disables the hardware.

#### **2.21.6.3 USBD\_attach**

```
void USBD_attach ( void )
```

Attach USB hardware.

Attaches the USB device to the USB host after a USBD\_detach call.

#### **2.21.6.4 USBD\_detach**

```
void USBD_detach ( void )
```

Detach USB hardware.

Detaches the USB device from the USB host. This will look like a device disconnect to the host and it will act like the device is removed.

#### **2.21.6.5 USBD\_is\_connected**

```
int8_t USBD_is_connected ( )
```

Check if the device is connected to a host (or external power source).

Checks the VBUS detect line for a host connected.

#### **2.21.6.6 USBD\_set\_state**

```
void USBD_set_state ( USBD_STATE state )
```

Set USB state.

Sets the current state of the current USB device. Please refer to section 9.1 of the USB 2.0 spec for more information.

#### Parameters

[in] **state** The new state of the current USB device.

#### **2.21.6.7 USBD\_create\_endpoint**

```
int8_t USBD_create_endpoint ( USBD_ENDPOINT_NUMBER ep_number,  
                             USBD_ENDPOINT_TYPE ep_type,
```

```

        USBD_ENDPOINT_DIR        ep_dir,
        USBD_ENDPOINT_SIZE      ep_size,
        USBD_ENDPOINT_DB        ep_db,
        void *                   ep_cb
    )

```

Create a USB endpoint.

Creates an endpoint with the requested properties.

There is a total of 2 kB of RAM for IN endpoints and another 2 kB for OUT endpoints (excluding the RAM allocated to endpoint 0). Therefore, the total max packet for all IN endpoints and OUT endpoints must be less than this figure. If double buffering is employed for an endpoint, then it will use twice the amount of RAM.

#### Parameters

[in] <b>ep_number</b>	USB endpoint number. (N/A for control endpoints).
[in] <b>ep_type</b>	USB endpoint type: BULK, ISO or INT. (N/A for control endpoints).
[in] <b>ep_dir</b>	Endpoint direction, In or Out.
[in] <b>ep_size</b>	USB endpoint max packet size in bytes.
[in] <b>ep_db</b>	USB endpoint double buffering enable. (N/A for control endpoints).
[in] <b>ep_cb</b>	Deprecated: Callback functions for this endpoint. This function was called from the USBD_process function when an event concerned with the endpoint had occurred. This was used for receiving notification of a transaction to or from the endpoint heralding the availability of data (OUT endpoints) or the completion of a transmission of data (IN endpoints). However, the <b>USB ep_buffer_full()</b> function can be polled to determine the same status if callbacks are inappropriate.

#### Returns

USB\_OK if successful.

USB\_ERR\_NOT\_SUPPORTED if an endpoint higher than the maximum number of endpoints is requested.

USB\_ERR\_INVALID\_PARAMETER if an illegal endpoint size is requested.

USB\_ERR\_RESOURCES if there is not enough endpoint RAM for the endpoint size requested.

#### 2.21.6.8 USB\_free\_endpoint

```
int8_t USB_free_endpoint ( USB_ENDPOINT_NUMBER ep_number )
```

Free USB endpoint.

Disable and free the specified endpoint.

#### Parameters

[in] <b>ep</b>	USB endpoint handle.
----------------	----------------------

#### Returns

USB\_OK if successful

USB\_ERR\_NOT\_CONFIGURED if endpoint is not configured.

USB\_ERR\_INVALID\_PARAMETER if endpoint number not allowed.

### **2.21.6.9 USBD\_connect**

int8\_t USBD\_connect ( void )

Connect to a USB host.

Checks the VBUS detect line for a host connected and proceed to allow the device to negotiate a connection to the host.

#### **Returns**

USB\_OK on success.

USB\_ERR\_INVALID\_PARAMETER if req is invalid.

### **2.21.6.10 USBD\_timer**

void USBD\_timer ( void )

USB timer.

To be called every millisecond from an interrupt handler to provide timeout support for USB device transactions. This will check all pending transfers, decrement timeout values and expire any timed-out transactions.

### **2.21.6.11 USBD\_process**

int8\_t USBD\_process ( void )

USB process.

To be continuously called by the user application or USB device thread. Checks for control endpoint transfer activity and invoke relevant callback. Manages suspend and resume states and power management.

#### **Returns**

Non-zero if USB transaction has been processed.

### **2.21.6.12 USBD\_transfer**

```
int32_t USBD_transfer ( USBD_ENDPOINT_NUMBER ep_number,  
                        uint8_t *           buffer,  
                        size_t _t           length  
                        )
```

Transfer data to/from a non-control USB endpoint.

USB IN or OUT request is implied from the settings of the endpoint passed as a parameter.

#### **Parameters**

- |                       |  |
|-----------------------|--|
| [in] <b>ep_number</b> | USB endpoint number.   |
| [in] <b>buffer</b>    | Appropriately sized buffer for the transfer.   |
| [in] <b>length</b>    | For IN transfers, the number of bytes to be sent.<br>For OUT transfers, the maximum number of bytes to read. |

#### **Returns**

The number of bytes actually transferred.

USB\_ERR\_NOT\_CONFIGURED if endpoint is not configured.

USB\_ERR\_INVALID\_PARAMETER if endpoint number not allowed.



### 2.21.6.13 USBD\_transfer\_ex

```
int32_t USBD_transfer_ex ( USBD_ENDPOINT_NUMBER ep_number,
                          uint8_t *          buffer,
                          size_t_t          length,
                          int8_t           part,
                          size_t           offset
                          )
```

Transfer data to/from a non-control USB endpoint with options.

USB IN or OUT request is implied from the settings of the endpoint passed as a parameter. The end-of-packet will not be sent when the data from the buffer parameter is sent.

This will allow a follow-on USBD\_transfer\_ex call to either send more data (with the part parameter non-zero and a correct offset set) or an end-of-packet with part not set.

This allows a USB data packet to a non-control endpoint to be formed from multiple calls with data from potentially different places.

#### Parameters

[in] <b>ep_number</b>	USB endpoint number.
[in] <b>buffer</b>	Appropriately sized buffer for the transfer.
[in] <b>length</b>	For IN transfers, the number of bytes to be sent. For OUT transfers, the maximum number of bytes to read.
[in] <b>part</b>	Signifies that this is a partial transfer.
[in] <b>offset</b>	Offset (within the current packet) from where to continue for subsequent calls when using partial packets.

#### Returns

The number of bytes actually transferred.

USB\_ERR\_NOT\_CONFIGURED if endpoint is not configured.

USB\_ERR\_INVALID\_PARAMETER if endpoint number not allowed.

### 2.21.6.14 USBD\_transfer\_ep0

```
int32_t USBD_transfer_ep0 ( USBD_ENDPOINT_DIR dir,
                          uint8_t *          buffer,
                          size_t           dataLength,
                          size_t           requestLength
                          )
```

Transfer data to/from a USB control endpoint.

Endpoint number is assumed to be zero.

#### Parameters

[in] <b>dir</b>	Control endpoint data direction.
[in] <b>buffer</b>	Appropriately sized buffer for the transfer.
[in] <b>dataLength</b>	For IN transfers, the number of bytes to be sent. For OUT transfers,

the maximum number of bytes to read.

[in] **requestLength** The number of bytes requested by the host in the wLength field of the SETUP packet.

#### Returns

The number of bytes actually transferred.  
USBD\_ERR\_NOT\_CONFIGURED if endpoint is not configured.

#### 2.21.6.15 USBD\_clear\_endpoint

int8\_t USBD\_clear\_endpoint ( USBD\_ENDPOINT\_NUMBER ep\_number )

Clears endpoint stall.

Clears a stall from the specified endpoint. The default standard request handler will call this function for a CLEAR\_FEATURE endpoint request.

#### Parameters

[in] **ep\_number** USB endpoint number.

#### Returns

USBD\_OK if successful  
USBD\_ERR\_NOT\_CONFIGURED if endpoint is not configured.  
USBD\_ERR\_INVALID\_PARAMETER if endpoint number not allowed.

#### 2.21.6.16 USBD\_ep\_max\_size

uint16\_t USBD\_ep\_max\_size ( USBD\_ENDPOINT\_NUMBER ep\_number )

Find Max Packet Size of USB endpoint.

#### Parameters

[in] **ep\_number** USB endpoint number.

#### Returns

Return the maximum number of bytes which can be sent or received single USB packets for an endpoint.

USBD\_ERR\_NOT\_CONFIGURED if the endpoint is not configured.  
USBD\_ERR\_INVALID\_PARAMETER if the endpoint number is not allowed.

#### 2.21.6.17 USBD\_ep\_buffer\_full

int8\_t USBD\_ep\_buffer\_full ( USBD\_ENDPOINT\_NUMBER ep\_number )

Get USB endpoint buffer status.

Returns the current buffer status of an endpoint using the SELECT\_ENDPOINT call.

#### Parameters

[in] **ep\_number** USB endpoint number.

#### Returns

Current state of the endpoint buffer. TRUE if full, FALSE if empty.

#### 2.21.6.18 USBD\_get\_ep\_stalled

int8\_t USBD\_get\_ep\_stalled ( USBD\_ENDPOINT\_NUMBER ep\_number )

Get USB endpoint stall status.

Returns the current stall status of an endpoint using the SELECT\_ENDPOINT call.

#### Parameters

[in] **ep\_number** USB endpoint number.

#### Returns

Current stall state of the endpoint.

>0 if stalled, zero if not stalled.

USB\_ERR\_NOT\_CONFIGURED if the endpoint is not configured.

USB\_ERR\_INVALID\_PARAMETER if the endpoint number is not allowed.

#### **2.21.6.19 USBD\_stall\_endpoint**

int8\_t USBD\_stall\_endpoint ( USBD\_ENDPOINT\_NUMBER ep\_number )

Stall endpoint.

Stalls the specified endpoint. The default standard request handler will call this function for a SET\_FEATURE endpoint request.

#### Parameters

[in] **ep\_number** USB endpoint number.

#### Returns

USB\_OK if successful

USB\_ERR\_NOT\_CONFIGURED if the endpoint is not configured.

USB\_ERR\_INVALID\_PARAMETER if the endpoint number is not allowed.

#### **2.21.6.20 USBD\_get\_state**

USB\_STATE USBD\_get\_state ( void )

Get USB state.

Returns the current state of the current USB device. Please refer to section 9.1 of the USB 2.0 spec for more information.

#### Returns

Current state of the current USB device.

#### **2.21.6.21 USBD\_req\_get\_configuration**

int8\_t USBD\_req\_get\_configuration ( void )

Handles GET\_CONFIGURATION request.

Handles the DATA phase of a GET\_CONFIGURATION request from the host. The application has to respond with SETUP ACK or STALL. The default standard request handler will call this function; if the handler is overridden then the application must call this when this request is received.

#### Returns

USB\_OK on success.

USB\_ERR\_INVALID\_PARAMETER if req is invalid.

#### **2.21.6.22 USBD\_req\_set\_address**

int8\_t USBD\_req\_set\_address ( USB\_device\_request \* req )

Handles SET\_ADDRESS request.

Places the device in the ADDRESS state. The application has to respond with SETUP ACK or STALL. The default standard request handler will call this function; if the handler is overridden, then the application must call this when this request is received.

**Parameters**

[in] **req**      USB request.

**Returns**

USBD\_OK on success.

USBD\_ERR\_INVALID\_PARAMETER if req is invalid.

**2.21.6.23 USBD\_req\_set\_configuration**

```
int8_t USBD_req_set_configuration ( USB_device_request * req )
```

Handles SET\_CONFIGURATION request.

Places the device in the CONFIGURED state or puts it back into the ADDRESS state. The application has to respond with SETUP ACK or STALL. The default standard request handler will call this function; if the handler is overridden, then the application must call this when this request is received.

**Parameters**

[in] **req**      USB request.

**Returns**

USBD\_OK on success.

USBD\_ERR\_INVALID\_PARAMETER if req is invalid.

**2.21.6.24 USBD\_get\_remote\_wakeup**

```
uint8_t USBD_get_remote_wakeup ( void )
```

Get USB remote wakeup feature status.

Returns the current feature status of remote wakeup.

**Returns**

Current remote wakeup feature status. TRUE if enabled, FALSE if not enabled.

**2.21.6.25 USBD\_set\_remote\_wakeup**

```
void USBD_set_remote_wakeup ( void )
```

Set USB remote wakeup feature status.

**2.21.6.26 USBD\_clear\_remote\_wakeup**

```
void USBD_clear_remote_wakeup ( void )
```

Clear USB remote wakeup feature status.

**2.21.6.27 USBD\_wakeup**

```
void USBD_wakeup ( void )
```

Drive resume signalling upstream when remote wakeup is enabled.

### 2.21.6.28 USBD\_resume

```
void USBD_resume ( void )
```

When USB related events like host resume and host reset are detected, PM irq will be received if it is enabled. The firmware needs to remove the SUSPEND from the PHY by calling this function.

### 2.21.6.29 USBD\_ep\_data\_rx\_count(USB\_ENDPOINT\_NUMBER ep\_number)

```
void USBD_ep_data_rx_count ( USB_ENDPOINT_NUMBER ep_number )
```

Provides the size of the OUT packet that is yet to be read.

#### Parameters

[in] **ep\_number** USB endpoint number.

#### Returns

The number of bytes actually received.

USB\_ERR\_NOT\_CONFIGURED if endpoint is not configured.

## 2.21.7 Extended API Function Documentation

### 2.21.7.1 USBDX\_pipe\_init

```
bool USBDX_pipe_init ( struct USBDX_pipe *    pp,
                    uint8_t                  id,
                    uint8_t                  ep,
                    struct USBDX_urb *        urbs,
                    uint8_t *                 bufs,
                    uint8_t                  urb_count
                    )
```

Initialise the URB pipe for data transfer.

Application provides a linear space buffer to USB. An array of URBs is initialized by USB, dividing the linear space into small chunks (512 bytes for HS, 64 bytes for FS). Pipe is initialized by USB, pointing to its own URBs. Each endpoint is represented by a pipe structure. Application can create multiple pipes.

#### Parameters

[in] pp	Pipe structure that gets initialised by USB upon creation of pipe.
[in] id	USB_ENDPOINT_NUMBER for which a pipe has to be created.
[in] ep	USB_ENDPOINT_NUMBER with MSB bit set in case of IN Endpoints.
[in] urbs	URB structure that gets initialised by USB upon creation of pipe.
[in] bufs	A linear buffer to be passed by the application which gets divided into URBs.
[in] urb_count	Number of URBs.

#### Returns

'True' if pipe is created. 'False' if the input parameters are invalid.

**2.21.7.2 USBDX\_register\_on\_ready**

```
void USBDX_register_on_ready ( struct USBDX_pipe * pp,  
                               USBDX_callback    callback  
                               )
```

To register callback function for USB D READY event.

Application shall call this API to register their callback function to get notified of when USB D is ready to process the URBs.

**Parameters**

[in] pp            Pipe for which the callback function is associated to.  
[in] callback     Callback function to register.

**2.21.7.3 USBDX\_register\_on\_underrun**

```
void USBDX_register_on_underrun ( struct USBDX_pipe * pp,  
                                   USBDX_callback    callback  
                                   )
```

To register callback function for USB D UNDERRUN event.

Application shall call this API to register their callback function to get notified of when USB D is underrunning.

**Parameters**

[in] pp            Pipe for which the callback function is associated to.  
[in] callback     Callback function to register.

**2.21.7.4 USBDX\_force\_acquire\_urb\_for\_app**

```
struct USBDX_urb * USBDX_force_acquire_urb_for_app ( struct USBDX_pipe * pp )
```

Always returns a URB.

Application can choose to acquire URB even if it is still held by USB D.

**Parameters**

[in] pp            The pipe whose data is to be transferred to/from USB D

**Returns**

A URB.

**2.21.7.5 USBDX\_submit\_urb**

```
void USBDX_submit_urb ( struct USBDX_pipe * pp,  
                        struct USBDX_urb * urb  
                        )
```

Submit a URB to USB D.

The application fills the URB and submits to USB D through this API call. When a URB is submitted without filling, this will make USB D send a ZLP.

**Attention**

This function should be protected by critical section since it is called from application's context.

**Parameters**

- [in] pp     The pipe whose data is to be transferred to/from USBD.  
[in] urb     Filled URB.

**2.21.7.6 USBDX\_get\_app\_urbs**

```
uint8_t * USBDX_get_app_urbs ( const struct USBDX_pipe * pp,  
                               uint16_t len  
                               )
```

To get more than one URBs for application.

Application to use this API to get more than one URB from the USBD.

**Attention**

This function should be called to obtain the length before copying and submitting the URBs through `usbd_submit_urbs()`.

**Parameters**

- [in] pp     The pipe for which the data transfer is needed.  
[in] len     The length of the data that the application wants to transfer.

**Returns**

The length of the URBs that is available for application usage.

**2.21.7.7 USBDX\_submit\_urbs**

```
struct USBDX_urb * USBDX_submit_urbs ( struct USBDX_pipe * pp,  
                                       uint16_t len  
                                       )
```

To submit more than one URBs from application.

Application fills the URBs and submits to USBD through this API call.

**Attention**

This function should be protected by critical section since it is called from application's context.

**Parameters**

- [in] pp     The pipe whose data is to be transferred to/from USBD.  
[in] len     The length must be equal or smaller than the length that is got from `usbd_get_app_urbs()`.

**Returns**

The next available URB.

**2.21.7.8 USBDX\_pipe\_process**

```
void USBDX_pipe_process ( struct USBDX_pipe * pp )
```

The given pipe is processed to transfer the data to/from USB hardware endpoint.

**Attention**

This function has to be called from USBDX\_pipe\_isr implemented by the application.

**Parameters**

[in] pp      The pipe whose data is to be transferred to/from USB.

**2.21.7.9 USBDX\_pipe\_purge**

```
void USBDX_pipe_purge ( struct USBDX_pipe * pp )
```

To flush the pipe. (Purge the data in the urbs (URBs for a given pipe).

**Parameters**

[in] pp      Pipe for which data to be purged.

**2.21.7.10 USBDX\_pipe\_isr\_start**

```
void USBDX_pipe_isr_start ( void )
```

Container function before processing pipes.

Defined as a weak function in USB. Note: Application can implement this function.

**2.21.7.11 USBDX\_pipe\_isr\_stop**

```
void USBDX_pipe_isr_stop ( void )
```

Container function after processing pipes.

Defined as a weak function in USB. **Note:** Application can implement this function.

**2.21.7.12 USBDX\_pipe\_isr**

```
void USBDX_pipe_isr ( uint16_t pipe_bitfields )
```

Asynchronous data transfer in USB.

Defined as a weak function in USB. **Note:** Application needs to implement this function.

**Parameters**

[in] pipe\_bitfields      Bits corresponding to Endpoint USBDX\_pipe for which USBDX\_pipe\_process has to be called.

**2.21.7.13 usbdx\_urb\_get\_id**

```
static inline uint8_t usbdx_urb_get_id ( const struct USBDX_urb * urb )
```

Inline function to get the id of the URB.

**Parameters**

[in] urb      Filled URB.

**Returns**

The id of the URB.



**2.21.7.14 usbdx\_urb\_get\_app\_to\_process**

```
static inline uint16_t usbdx_urb_get_app_to_process ( const struct USBDX_urb * urb )
```

Inline function to get length of the USB data available to be processed by the application.

**Parameters**

[in] urb          Filled URB.

**Returns**

The remaining length of the URB data.

**2.21.7.15 usbdx\_urb\_get\_app\_consumed**

```
static inline uint16_t usbdx_urb_get_app_consumed ( const struct USBDX_urb * urb )
```

Inline function to get length of the USB data consumed by the application.

**Parameters**

[in] urb          Filled URB.

**Returns**

The length of the URB data already consumed.

**2.21.7.16 usbdx\_urb\_in\_fully\_filled**

```
static inline bool usbdx_urb_in_fully_filled ( const struct USBDX_urb * urb )
```

Inline function to detect if the buffer of an IN URB is full.

**Parameters**

[in] urb          Filled URB.

**Returns**

True if the buffer is full.

**2.21.7.17 usbdx\_urb\_in\_empty**

```
static inline bool usbdx_urb_in_empty ( const struct USBDX_urb * urb )
```

Inline function to detect if the buffer of an IN URB is empty.

**Parameters**

[in] urb          Filled URB.

**Returns**

True if the buffer is empty.

**2.21.7.18 usbdx\_urb\_owned\_by\_app**

```
static inline bool usbdx_urb_owned_by_app ( const struct USBDX_urb * urb )
```

Inline function to detect if the application owns a URB.

**Parameters**

[in] urb          Filled URB.

**Returns**

True if the application is free to use the URB.

**2.21.7.19 usbdx\_get\_app\_urb**

```
static inline USBDX_urb * usbdx_get_app_urb ( const struct USBDX_pipe * pp )
```

Inline function to get the next application URB pointer. It may still be held by USB engine at this point so must be checked with `urb_owned_by_app` to know the ownership.

**Parameters**

[in] pp          Pipe from which to find the next URB.

**Returns**

A URB.

**2.21.7.20 usbdx\_set\_app\_paused**

```
static inline void usbdx_set_app_paused ( const struct USBDX_pipe * pp )
```

Inline function to pause the pipe. An application will pause itself when no buffer can be processed, and it is waiting for USB engine to give more data. The USB engine will call the `on_usb_ready` callback once the app is paused, to resume the application's processing.

**Parameters**

[in] pp          Pipe to pause.

**2.21.7.21 usbdx\_is\_engine\_paused**

```
static inline USBDX_urb * usbdx_is_engine_paused ( const struct USBDX_pipe * pp )
```

Inline function to get the status of a pipe.

**Parameters**

[in] pp          Pipe to check.

**Returns**

True if the pipe is paused.

## 2.22 DFU Device for USB Device Stack API

The file **ft900\_usbd\_dfu.h** contains the definitions for the USB DFU device functions in the `libft900.a` and `libft930.a` libraries.

API functions for USB Device DFU interfaces. These functions provide functionality required to communicate with a DFU application through the USB Device interface.

Please consult the Device Firmware Upgrade 1.1 Specification from the USB-IF for details of the DFU state machine employed in this driver.

**2.22.1 API Cross Reference**

It utilises the following library APIs:

**ft900\_gpio.h** – General Purpose I/O and Pad Control

**ft900\_sys.h** – Chip Management

**ft900\_delay.h** – Delay

**ft900\_interrupt.h** – Interrupt Management

Additional definitions are taken from:

**ft900\_usbh\_internal.h** – Internal-only USB host definitions

**ft900\_usb.h** – General USB definitions

**ft900\_registers.h** – FT90x and FT93x register definitions

## 2.22.2 Macro Definition Documentation

### 2.22.2.1 *USBD\_DFU\_ATTRIBUTES*

```
#define USBD_DFU_ATTRIBUTES
```

**Value:**

```
(USB_DFU_BMATtributes_CANDNLOAD |  
USB_DFU_BMATtributes_WILLDETACH |  
USB_DFU_BMATtributes_CANUPLOAD)
```

Sets the default feature support for the DFU library. This will allow firmware uploads (read of device firmware), downloads (program device firmware) and device detach (no USB reset needs to be generated by the host).

### 2.22.2.2 *USBD\_DFU\_MAX\_BLOCK\_SIZE*

```
#define USBD_DFU_MAX_BLOCK_SIZE
```

**Value:**

256

Sets the maximum size of a download or upload block for the library. The physical addresses calculated for programs are based on this value.

### 2.22.2.3 *USBD\_DFU\_TIMEOUT*

```
#define USBD_DFU_TIMEOUT
```

**Value:**

0x2000

The timeout (in milliseconds) used to revert to the appIDLE state after a DFU\_DETACH request if a USB reset is not received. This is not applicable when the USB\_DFU\_BMATtributes\_WILLDETACH bit is set in the attributes.

## 2.22.3 Function Documentation

### 2.22.3.1 *USBD\_DFU\_timer*

```
uint8_t USBD_DFU_timer ( void )
```

Decrements the detach\_counter and adjusts state accordingly.

If the state is appDETACH, move to dfuIDLE state if we have been in the appDETACH state longer than the attach timeout specified by the DFU\_DETACH request.

**Note:** This is run from INTERRUPT LEVEL as a handler for an ISR.

The bmAttributes value set in the USBD\_DFU\_ATTRIBUTES determines the actions that are taken upon a timer event (i.e., may call a detach).

## Parameters

**attributes** - The bmAttributes value set in the DFU functional descriptor.  
This determines the actions that are taken upon a reset.

## Returns

Zero if timer running, non-zero if timer expired.

### 2.22.3.2 USBDFU\_reset

```
uint8_t USBDFU_reset ( void )
```

Implementation of USB reset state handler for DFU.

Reset or advance the DFU state machine when a USB reset is encountered. This will change the state to dfuIDLE if it was in appDETACH state before. It will change to dfuERROR if a download was in progress. Otherwise, it will return to appIDLE.

Return a byte to the host indicating if the next state change of the DFU state machine byte requires code to be reloaded and run. i.e., a new program needs to be run. The bmAttributes value set in the USBDFU\_ATTRIBUTES determines the actions that are taken upon a reset.

## Returns

status - non-zero if new program is to be run.

### 2.22.3.3 USBDFU\_is\_runtime

```
uint8_t USBDFU_is_runtime ( void )
```

Determine current mode of DFU.

## Returns

Returns non-zero if the DFU state machine is in runtime mode.

### 2.22.3.4 USBDFU\_set\_dfumode

```
void USBDFU_set_dfumode ( void )
```

Force a transition into DFU mode. There is no detaching. This is used when the run-time mode is not used.

### 2.22.3.5 USBDFU\_class\_req\_detach

```
void USBDFU_class_req_detach ( uint16_t timeout )
```

USB class request handler for DFU\_DETACH.

Move the state machine to appDETACH state from appIDLE and initialise a timeout within which time the host should set a USB reset on the bus. An ACK packet is sent on the USB control IN endpoint to the host to acknowledge successful completion of this request. The bmAttributes value set in the USBDFU\_ATTRIBUTES determines the actions that are taken upon a detach.

## Parameters

[in] **timeout** - Number of milliseconds timeout before reverting to appIDLE if no USB reset is forthcoming from the host.

### 2.22.3.6 USBDFU\_class\_req\_getstate

```
void USBDFU_class_req_getstate ( uint16_t requestLen )
```

USB class request handler for DFU\_GETSTATE.

Return a single byte to the host containing the current DFU state machine byte. The data is written via the control IN endpoint to the host.

#### Parameters

**requestLen** - Number of bytes requested by the host.

#### **2.22.3.7 USBDFU\_class\_req\_getstatus**

```
void USBDFU_class_req_getstatus ( uint16_t requestLen )
```

USB class request handler for DFU\_GETSTATUS.

Return a structure to the host containing the current DFU state machine and status bytes. These are used by the application on the host to work out whether any errors have occurred and what the status of the device is. The structure is written via the control IN endpoint to the host. The bmAttributes value set in the USBDFU\_ATTRIBUTES determines the actions that are taken upon a GET\_STATUS.

#### Parameters

**requestLen** - Number of bytes requested by the host.

#### **2.22.3.8 USBDFU\_class\_req\_download**

```
void USBDFU_class_req_download ( uint32_t block,  
                                uint16_t dataLength  
                                )
```

USB class request handler for DFU\_DNLOAD.

Receive blocks of firmware from the host on the control OUT endpoint and program these into the MTP. If the state machine is in dfuIDLE, then move to dfuDNLOAD\_IDLE state.

If zero length data is received indicating the end of the firmware, then move the state machine to dfuMANIFEST\_WAIT\_RESET. If an address or data length error are detected, then move to the dfuERROR state. An ACK packet is sent on the USB control IN endpoint to the host to acknowledge successful completion of this request. If the bmAttributes value set in the USBDFU\_ATTRIBUTES do not support download, then this function will have no body.

#### Parameters

[in] **address** - starting address of data to program. It is up to the calling program to make sure this is calculated correctly.

[in] **dataLength** - Number of bytes to program. This can be between the control endpoint max packet size and DFU\_MAX\_BLOCK\_SIZE.

#### **2.22.3.9 USBDFU\_class\_req\_upload**

```
void USBDFU_class_req_upload ( uint32_t block,  
                               uint16_t dataLength  
                               )
```

USB class request handler for DFU\_UPLOAD.

Receive blocks of firmware from the Flash to the control IN endpoint. If the state machine is in dfuIDLE, then move to dfuUPLOAD\_IDLE. If an address or data length error are detected, then move to the dfuERROR state. An ACK packet is sent on the USB control IN endpoint to the host to acknowledge successful completion of this request. If the bmAttributes value set in the USBDFU\_ATTRIBUTES do not support upload, then this function will have no body.

## Parameters

- [in] **address** - starting address of data to read. It is up to the calling program to make sure this is calculated correctly.
- [in] **dataLength** - Number of bytes to read. This can be between the control endpoint max packet size and DFU\_MAX\_BLOCK\_SIZE.

### **2.22.3.10 USBDFU\_class\_req\_clrstatus**

```
void USBDFU_class_req_clrstatus ( void )
```

USB class request handler for DFU\_CLRSTATUS.

Clears an error state for the DFU state machine.

### **2.22.3.11 USBDFU\_class\_req\_abort**

```
void USBDFU_class_req_abort ( void )
```

USB class request handler for DFU\_ABORT.

Aborts transaction and resets the DFU state machine.

### **2.22.3.12 USBDFU\_is\_wait\_reset**

```
uint8_t USBDFU_is_wait_reset ( void )
```

Determine if DFU waiting to reset.

## Returns

Returns non-zero if the DFU state machine is in dfuMANIFEST-WAIT-RESET and is therefore waiting for a host reset or detach/attach sequence. If the bmAttributes value set in the USBDFU\_ATTRIBUTES do support manifestation, then this function should not be required.

## **2.23 High Bandwidth Isochronous IN support in USB Device Stack API**

The file **ft900\_usbd\_hbw.h** contains the definitions for the USB Device High Bandwidth Isochronous IN transfer (more than 1024 bytes and less than 3073 bytes per microframe). The APIs are supported for **FT90x Revision C onwards** (in the **libft900.a** library).

API functions for creating a high-bandwidth isochronous IN pipe and performing high-bandwidth isochronous transfers. There is no high-bandwidth isochronous pipe support in FT93x devices.

### **2.23.1 API Cross Reference**

It utilises the following library APIs:

**ft900\_usb.h** – General USB definitions

**ft900\_registers.h** – FT90x register definitions

### **2.23.2 Macro Definition Documentation**

#### **2.23.2.1 USBDFU\_HBW\_ISOCHRONOUS\_AUTOHEADER**

```
#define USBDFU_HBW_ISOCHRONOUS_AUTOHEADER
```

When defined, it means the UVC payload header is generated and inserted by the hardware automatically whereas the firmware only has to feed the payload data to the Isochronous IN endpoint buffer, checking the space availability in the buffer. The hardware automatically inserts the UVC header - USB\_UVC\_Payload\_Header\_PTS. The PTS (presentation time stamp) engine SCR (Source clock reference) engine in the hardware can be enabled to send the Presentation time and Source clock reference in this payload header. By default, the PTS engine and SCR engine are not enabled in the configuration. When the end of video frame is reached, firmware has to notify the sequence end to the hardware which then automatically generates the frame end payload for UVC.

When USBD\_HBW\_ISOCHRONOUS\_AUTOHEADER is disabled, the streaming firmware application has to supply the UVC header (USB\_UVC\_Payload\_Header or USB\_UVC\_Payload\_Header\_PTS).

### 2.23.3 Enumeration Type Documentation

#### 2.23.3.1 USBD\_HBW\_HBWMODE

enum USBD\_HBW\_HBWMODE

Enums used to configure whether the endpoint handles one or two or three 1024-byte packets per microframe

Enumerator	
USBD_HBW_TRANSACTION_1	Expect 1 ISO IN. (DATA0)
USBD_HBW_TRANSACTION_2	Expect 2 ISO IN. (DATA1/0)
USBD_HBW_TRANSACTION_3	Expect 2 ISO IN. (DATA2/1/0)

### 2.23.4 Function Documentation

#### 2.23.4.1 USBD\_HBW\_init\_endpoint

```
void USBD_HBW_init_endpoint(USBD_ENDPOINT_NUMBER ep_number,
                           uint16_t fifo_size,
                           USBD_HBW_HBWMODE mode);
```

Initializes HBW pipe and hooks up to a logical endpoint. This function need to be called after creation of IN endpoint using USBD\_create\_endpoint(). There is a total of 6 kB of RAM for all the endpoints EP1-7 (excluding the RAM allocated to endpoint 0). Out of 6kB, up to a maximum of 4kB of FIFO size can be configured for HBW isochronous IN pipe.

##### Parameters

<b>ep_number</b>	USB IN endpoint number. (N/A for control and OUT endpoints)
<b>fifo_size</b>	Define the FIFO size for HBW ISO IN pipe allocated in SRAM
<b>mode</b>	Number of ISO IN transactions in a USB microframe (enum USBD_HBW_HBWMODE).

##### Returns

None.

#### 2.23.4.2 USBD\_HBW\_iso\_transfer

```
int32_t USBD_HBW_iso_transfer(USBD_ENDPOINT_NUMBER ep_number,
                              uint8_t *buffer,
                              size_t length,
                              uint8_t part,
```

*size\_t offset);*

The data to be sent on the IN endpoint is copied to the FIFO in SRAM whenever at least 1 packet of data space is available there. The offset is useful in case UVC header information is passed from the application (within the current packet) and the data following the header is to be copied at an offset of header bytes.

#### Parameters

<b>ep_number</b>	USB IN endpoint number
<b>buffer</b>	Appropriately sized buffer for the transfer
<b>length</b>	the number of bytes to be sent
<b>part</b>	UNUSED
<b>offset</b>	Offset (within the current packet) from where to continue for subsequent calls when using partial packets

#### Returns

The number of bytes actually transferred.

#### 2.23.4.3 *USBD\_HBW\_is\_fifo\_full*

Int8\_t USBD\_HBW\_is\_fifo\_full ( void )

Reads from HW register and indicates HBW FIFO status.

#### Returns

Returns 1 if status of HBW FIFO is full. Returns 0 if not full.

#### 2.23.4.4 *USBD\_HBW\_is\_space\_avail*

Int8\_t USBD\_HBW\_is\_space\_avail ( void )

Reads from HW register and indicates if at least 1 burst space (1024) is available.

#### Returns

Returns 1 if at least 1 burst space for data is available. Returns 0 if not enough space.

#### 2.23.4.5 *USBD\_HBW\_send\_end\_of\_frame*

void USBD\_HBW\_send\_end\_of\_frame ( void )

Sets SEQEND to terminate a video frame so that the hardware automatically generates the frame end payload for UVC, in case of USBD\_HBW\_ISOCHRONOUS\_AUTOHEADER configuration.

## 2.24 USB Host Stack API

The file **ft900\_usbh.h** contains the definitions for the USB host functions in the libft900.a library.

This contains USB Host API function definitions, constants and structures which are exposed in the API.

### 2.24.1 API Cross Reference

It utilises the following library APIs:

**ft900\_gpio.h** – General Purpose I/O and Pad Control

**ft900\_sys.h** – Chip Management



**ft900\_delay.h** – Delay

**ft900\_interrupt.h** – Interrupt Management

Additional definitions are taken from:

**ft900\_usb.h** – General USB definitions

**ft900\_registers.h** – FT90x register definitions

## **2.24.2 Macro Definition Documentation**

### **2.24.2.1 Library status values.**

```
#define USBH_OK 0x00
```

Success for USB Host function.

```
#define USBH_ENUM_NO_CHANGE 1
```

No change in enumeration. This status does not constitute an error condition.

```
#define USBH_ENUM_PARTIAL 2
```

Partial enumeration only. The enumeration process did not have enough resources to completely enumerate all devices on the USB. This may constitute an error.

```
#define USBH_ERR_RESOURCES -1
```

Lack of resources to perform USB Host function.

```
#define USBH_ERR_USBERR -2
```

Host controller completed and reported an error.

```
#define USBH_ERR_HOST_HALTED -3
```

Host controller halted.

```
#define USBH_ERR_NOT_FOUND -4
```

Endpoint, Device or Interface not found.

```
#define USBH_ERR_REMOVED -5
```

Endpoint, Device or Interface removed.

```
#define USBH_ERR_STALLED -6
```

Endpoint stalled.

```
#define USBH_ERR_TIMEOUT -8
```

Endpoint transaction timeout.

```
#define USBH_ERR_PARAMETER -15
```

Request parameter error.

```
#define USBH_ERR_HALTED -16
```

Transaction completed with halted state.

```
#define USBH_ERR_DATA_BUF -17
```

Endpoint data underun or overrun.

```
#define USBH_ERR_BABBLE -18
```

Endpoint data babble detected.

```
#define USBH_ERR_MISSED_MICROFRAME -20
```

Endpoint data missed microframe.

### 2.24.2.2 *Predefined Handles*

```
#define USBH_ROOT_HUB_HANDLE 0
```

Handle used to access Root hub.

```
#define USBH_ROOT_HUB_PORT 0
```

Port used to access Root hub.

```
#define USBH_HUB_ALL_PORTS 0
```

Port used to access all devices on a hub.

### 2.24.3 Typedef Documentation

#### 2.24.3.1 *USBH\_callback*

```
typedef int8_t(* USBH_callback) (uint32_t id, int8_t status, uint16_t len, uint8_t *buffer)
```

USB callback used when completing a transaction or receiving a notification from the USBH library. It is not permissible to make a call to **USBH\_transfer\_async()** and specify a callback function. This will produce unspecified results.

#### Parameters

[in] <b>id</b>	Identifier for completed transaction
[in] <b>status</b>	Status of operation that caused callback
[in] <b>len</b>	Size of data buffer
[in] <b>buffer</b>	Pointer to data buffer

#### Returns

USBH\_OK if the request was handled successfully.  
USBH\_ERR\_\* depending on function.

#### 2.24.3.2 *Device, Endpoint and Interface Handles*

Handles are used to pass devices, interfaces and endpoints to the application. (Pointers to the USBH\_device, USBH\_interface and USBH\_endpoint structures are not allowed as these are only used internally.) The handles allow embedding an enumeration value to detect stale handles which have been retained by the application. Enumeration is a dynamic operation and devices may appear and disappear without warning. This makes sure that new devices cannot be mistakenly used by an old handle.

```
typedef uint32_t USBH_device_handle
```

Structure that is used to store a handle to a device within an application. It is made up of a pointer to the device structure and a unique value to detect enumeration changes and hence stale handles.

```
typedef uint32_t USBH_endpoint_handle
```

Structure that is used to store a handle to an endpoint within an application. It is made up of a pointer to the endpoint structure and a unique value to detect enumeration changes and hence stale handles.

```
typedef uint32_t USBH_interface_handle
```

Structure that is used to store a handle to an interface within an application. It is made up of a pointer to the interface structure and a unique value to detect enumeration changes and hence stale handles.

### 2.24.3.3 Endpoint Information

```
typedef uint8_t USBH_ENDPOINT_NUMBER
```

USB Endpoint Numbers.

```
typedef uint16_t USBH_ENDPOINT_SIZE
```

USB Endpoint Sizes.

### 2.24.4 Structure Documentation

#### 2.24.4.1 USBH\_ctx

Struct containing configuration data for the USB EHCI controller, USBH memory space allocation, callback functions for USB events.

##### Data Fields

```
USBH_callback enumeration_change
```

##### Field Documentation

enumeration\_change

**CURRENTLY NOT IMPLEMENTED.** Enumeration state callback function. Optional. TBD: return a code and maybe a structure to indicate what has changed and how.

#### 2.24.4.2 USBH\_device\_info

Structure containing current information about a device.

##### Data Fields

```
uint8_t port_number
```

```
uint8_t Addr
```

```
uint8_t Speed
```

```
uint8_t Configuration
```

```
uint8_t num_configurations
```

##### Field Documentation

port\_number

Port number on parent hub.

addr

Configured address on USB bus.

speed

Current USB bus speed for device. Definitions in USBH\_ENDPOINT\_SPEED.

0 - Low speed. 1 - Full speed. 2 - High speed.

configuration

Active configuration for this device currently set with SET\_CONFIGURATION.

num\_configurations

Total number of configurations for this device.

#### 2.24.4.3 USBH\_interface\_info

Structure containing current information about an interface.

##### Data Fields

USBH_device_handle	dev
uint8_t	interface_number
uint8_t	alt

##### Field Documentation

dev

Handle to the parent device of this interface.

interface\_number

Interface number from Interface Descriptor.

alt

Alternate setting for this interface currently set with SET\_INTERFACE.

#### 2.24.4.4 USBH\_endpoint\_info

Structure containing current information about an endpoint.

##### Data Fields

USBH_interface_handle	iface
USBH_ENDPOINT_NUMBER	index
USBH_ENDPOINT_DIR	direction
USBH_ENDPOINT_SIZE	max_packet_size
USBH_ENDPOINT_TYPE	type

##### Field Documentation

iface

Handle to the parent interface of this endpoint.

index

Encodes USB endpoint number (0-127).

direction

The direction can be one of USBH\_DIR\_OUT, USBH\_DIR\_IN, or USBH\_DIR\_SETUP.

max\_packet\_size

Endpoint max packet size.

type

The endpoint type can be one of USBH\_EP\_TYPE\_DISABLED, USBH\_EP\_BULK, USBH\_EP\_INT, USBH\_EP\_ISOC, or USBH\_EP\_CTRL.

## 2.24.5 Enumeration Type Documentation

### 2.24.5.1 USBH\_STATE

enum USBH\_STATE

USB Root Hub Connection States.

Enumerator	
USBH_STATE_NOTCONNECTED	No device is attached to USB root hub.
USBH_STATE_CONNECTED	Device is attached to USB root hub.
USBH_STATE_ENUMERATED	Device is attached successfully and enumerated. All downstream devices have also been successfully enumerated.
USBH_STATE_ENUMERATED_PARTIAL	Device is attached and has been partially enumerated. There may be more devices, interfaces or endpoints connected than configured. Some devices may be missing interfaces and/or endpoints. It is conceivable that some downstream devices may not be configured at all.

### 2.24.5.2 USBH\_CONTROLLER\_STATE

enum USBH\_CONTROLLER\_STATE

USB Host Controller State describing if the host is operational or suspending or resuming. Used to control transitions between these states.

Enumerator	
USBH_CONTROLLER_STATE_RESET	Controller reset and uninitialized.
USBH_CONTROLLER_STATE_OPERATIONAL	Controller initialised and operational.
USBH_CONTROLLER_STATE_SUSPENDING	Controller performing a suspend. Transitioning from operational to suspend.
USBH_CONTROLLER_STATE_SUSPEND	Controller in suspend state. No SOFs generated.
USBH_CONTROLLER_STATE_RESUME	Controller performing a resume. Transitioning from suspend to operational.

### 2.24.5.3 USBH\_ENDPOINT\_DIR

enum USBH\_ENDPOINT\_DIR

USB Endpoint Direction.

Enumerator	
USBH_DIR_OUT	Direction host to device
USBH_DIR_IN	Direction device to host
USBH_DIR_SETUP	Force a SETUP PID to a control endpoint.

#### 2.24.5.4 USBH\_ENDPOINT\_SPEED

enum USBH\_ENDPOINT\_SPEED

USB Endpoint Speed.

Enumerator	
USBH_SPEED_LOW	Low speed
USBH_SPEED_FULL	Full speed
USBH_SPEED_HIGH	High speed

#### 2.24.5.5 USBH\_ENDPOINT\_TYPE

enum USBH\_ENDPOINT\_TYPE

USB Endpoint Types.

Enumerator	
USBH_EP_TYPE_DISABLED	Disabled.
USBH_EP_BULK	Bulk Endpoint.
USBH_EP_INT	Interrupt Endpoint.
USBH_EP_ISOC	Isochronous Endpoint.
USBH_EP_CTRL	Control Endpoint.

### 2.24.6 Function Documentation

#### 2.24.6.1 USBH\_initialise

```
void USBH_initialise ( USBH_ctx * ctx )
```

Initialise USB hardware.

Performs a software reset and initialises the USB hardware.

The USBH\_ctx contains function pointers to the application for handling USB events. Currently only an enumeration change event is implemented. This function MUST be called prior to any further call to the USB functions.

##### Parameters

[in] **ctx**      USB context.

#### 2.24.6.2 USBH\_finalise

```
void USBH_finalise ( void )
```

Finalise USB hardware.

Releases any resources associated with the USB driver and disables the hardware.

#### 2.24.6.3 USBH\_enumerate

```
int8_t USBH_enumerate ( USBH_device_handle hub,
                        uint8_t port
                        )
```

Force a re-enumeration of a hub.

Select a hub to force re-enumeration. To enumerate the root hub, the handle is set to USBH\_ROOT\_HUB\_HANDLE or zero. To enumerate all ports on a hub, set the port value to USBH\_HUB\_ALL\_PORTS or zero.

**Note:** The USBH\_process call will monitor the Root hub and downstream hubs to manage the connection/removal of devices and enumeration of devices.

#### Parameters

[in] **hub** Handle to hub device.

[in] **port** Port on hub.

#### Returns

USBH\_OK if successful.  
USBH\_ERR\_NOT\_FOUND if hub handle is invalid.  
USBH\_ERR\_RESOURCES if there are insufficient resources.  
USBH\_ERR\_\* depending on USB bus errors.

#### 2.24.6.4 USBH\_process

```
int8_t USBH_process ( void )
```

To be continuously called by the user application. Checks for asynchronous transfer completions and root hub events.

When a root hub connection is detected, then the enumeration routine is called automatically. There is no requirement to call USBH\_enumerate if USBH\_process is called periodically.

#### Parameters

[in] **Nothing**

#### Returns

Non-zero if USB transaction has been processed.

#### 2.24.6.5 USBH\_timer

```
void USBH_timer ( void )
```

To be called every millisecond from an interrupt handler to provide timeout support for USB host transactions. This will check all pending transfers, decrement timeout values and expire any timed-out transactions.

#### 2.24.6.6 USBH\_transfer

```
int32_t USBH_transfer ( USBH_endpoint_handle endpoint,  
                        uint8_t *          buffer,  
                        size_t             length,  
                        uint16_t           timeout  
                        )
```

Transfer data to/from a USB endpoint.

USB IN or OUT request is implied from the ep parameter. This is a blocking call to complete a transaction.

## Parameters

[in] <b>endpoint</b>	Endpoint to address.
[in] <b>buffer</b>	Appropriately sized buffer for the transfer.
[in] <b>length</b>	For IN transfers, the number of bytes to be sent. For OUT transfers, the maximum number of bytes to read.
[in] <b>timeout</b>	Number of milliseconds to wait for response.

## Returns

Number of bytes transferred if successful. (i.e.,  $\geq 0$ )  
 USBH\_ERR\_NOT\_FOUND if endpoint handle is invalid.  
 USBH\_ERR\_RESOURCES if there are insufficient resources.  
 USBH\_ERR\_\* depending on USB bus errors.

### 2.24.6.7 USBH\_transfer\_async

```
int32_t USBH_transfer_async ( USBH_endpoint_handle endpoint,
                             uint8_t *          buffer,
                             size_t             length,
                             uint16_t           timeout,
                             uint32_t           id,
                             USBH_callback      cb
                             )
```

Asynchronously transfer data to/from a USB endpoint.

USB IN or OUT request is implied from the ep parameter. This is a blocking call to complete a transaction.

## Parameters

[in] <b>endpoint</b>	Endpoint to address.
[in] <b>buffer</b>	Appropriately sized buffer for the transfer.
[in] <b>length</b>	For IN transfers, the number of bytes to be sent. For OUT transfers, the maximum number of bytes to read.
[in] <b>timeout</b>	Number of milliseconds to wait for response. Zero for infinite timeout.
[in] <b>id</b>	Identifier for asynchronous transaction. Passed to the callback function.
[in] <b>cb</b>	Callback function to notify application of completion of asynchronous transfer. Parameters for callback function are defined in the USBH_callback typedef. The status of the transaction and any pending data (from an IN) will be returned to the callback function. The function must return with minimum processing. When it returns, the USB_xfer structure is discarded and invalidated. It is not permissible to make further calls to this function from within the callback function. This will produce unspecified results. SETUP and blocking calls are allowed but may have a performance penalty on application code.

## Returns

Number of bytes transferred if successful. (i.e.,  $\geq 0$ ).  
 USBH\_ERR\_NOT\_FOUND if endpoint handle is invalid.



USBH\_ERR\_RESOURCES if there are insufficient resources.  
USBH\_ERR\_\* depending on USB bus errors.

#### **2.24.6.8 USBH\_get\_connect\_state**

```
int8_t USBH_get_connect_state ( USBH_device_handle hub,
                                uint8_t           port,
                                USBH_STATE *       state
                                )
```

Determine if a hub port has a downstream connection.

Select a hub and a port to query. For the root hub, the handle will be NULL and the port zero.

##### **Parameters**

[in] **hub**        Handle to hub device.  
[in] **port**        Port number on hub.  
[out] **state**      USBH\_STATE enumeration for current state of hub port connection.

##### **Returns**

USBH\_OK if successful.  
USBH\_ERR\_NOT\_FOUND if hub handle is invalid.  
USBH\_ERR\_\* if an error occurred when sending the request to a USB hub.

#### **2.24.6.9 USBH\_get\_controller\_state**

```
int8_t USBH_get_controller_state ( USBH_CONTROLLER_STATE * state )
```

Get host controller state.

Get the state of the host controller. This may be used by an application to check if the controller is in suspend or operational state. There are intermediate states which can be found during transitions from operational to suspend and back. Recommended to use explicit state tests, i.e., "if state is suspended" rather than "if state is not operational".

##### **Parameters**

[out] **state** State enum for host.

##### **Returns**

USBH\_OK if successful.

#### **2.24.6.10 USBH\_get\_frame\_number**

```
uint16_t USBH_get_frame_number ( void )
```

Get frame number.

Get the current frame number. This number increments when the host is operational and will cease to increment when host is suspended. This number is sent in the SOF.

##### **Returns**

Frame number (14-bit value).

#### **2.24.6.11 USBH\_get\_device\_count**

```
int8_t USBH_get_device_count ( USBH_device_handle device,
```

```

        uint8_t *    count
    )

```

Get device count.

Get the count of child device enumerated for a device. For devices on the root hub, the handle is set to USBH\_ROOT\_HUB\_HANDLE.

#### Parameters

[in] <b>device</b>	Count child devices on this device
[out] <b>count</b>	Number of child devices

#### Returns

USBH\_OK if successful.  
 USBH\_ERR\_NOT\_FOUND if device handle is invalid.

#### 2.24.6.12 USBH\_get\_device\_list

```

int8_t USBH_get_device_list ( USBH_device_handle  device,
                             USBH_device_handle * child
                             )

```

Get device list.

Get the first child device of a device. The function will return a handle to a device if there are one or more child devices. For devices on the root hub, the handle is set to USBH\_ROOT\_HUB\_HANDLE. If there are no interfaces, then a NULL is returned.

#### Parameters

[in] <b>device</b>	Handle to a device.
[out] <b>child</b>	Handle to first child device.

#### Returns

USBH\_OK if successful.  
 USBH\_ERR\_NOT\_FOUND if device handle is invalid.

#### 2.24.6.13 USBH\_get\_next\_device

```

int8_t USBH_get_next_device ( USBH_device_handle  device,
                             USBH_device_handle * next
                             )

```

Get next device in list.

Get the next device in the list. The function will return a handle to the device if there are more devices. If there are no more devices, then a NULL is returned.

#### Parameters

[in] <b>device</b>	Handle to a device.
[in] <b>device</b>	Handle to a device.

#### Returns

USBH\_OK if successful.  
 USBH\_ERR\_NOT\_FOUND if device handle is invalid.

#### **2.24.6.14 USBH\_device\_get\_info**

```
int8_t USBH_device_get_info ( USBH_device_handle device,
                               USBH_device_info *  info
                               )
```

Get device information.

Get information of a device.

##### **Parameters**

[in] **device**      Handle to a device.  
[out] **info**        Structure to receive device information.

##### **Returns**

USBH\_OK if successful.  
USBH\_ERR\_NOT\_FOUND if device handle is invalid.

#### **2.24.6.15 USBH\_device\_get\_descriptor**

```
int8_t USBH_device_get_descriptor ( USBH_device_handle device,
                                     uint8_t             type,
                                     uint8_t             index,
                                     uint16_t            len,
                                     uint8_t *           buf
                                     )
```

Get a descriptor from a device.

Sends a GET\_DESCRIPTOR request to a device.

##### **Parameters**

[in] **device**      Handle to a device.  
[in] **type**        Configuration descriptor type.  
[in] **index**       Index of descriptor.  
[in] **len**         Configuration descriptor len (or number of bytes to read).  
[in] **buf**         Location to copy descriptor into.

##### **Returns**

USBH\_OK if successful.  
USBH\_ERR\_NOT\_FOUND if device handle is invalid.  
USBH\_ERR\_RESOURCES if there are insufficient resources.  
USBH\_ERR\_\* depending on USB bus errors.

#### **2.24.6.16 USBH\_device\_get\_configuration**

```
int8_t USBH_device_get_configuration ( USBH_device_handle device,
                                         uint8_t *           conf
                                         )
```

Gets the current configuration value of a device.

Sends a GET\_CONFIGURATION request to a device.

#### Parameters

[in] <b>device</b>	Handle to a device.
[out] <b>conf</b>	Current configuration value.

#### Returns

USBH\_OK if successful.  
USBH\_ERR\_NOT\_FOUND if device handle is invalid.  
USBH\_ERR\_RESOURCES if there are insufficient resources.  
USBH\_ERR\_\* depending on USB bus errors.

#### 2.24.6.17 USBH\_device\_get\_vid\_pid

```
int8_t USBH_device_get_vid_pid ( USBH_device_handle device,
                                uint16_t *          vid,
                                uint16_t *          pid
                                )
```

Get device VID and PID.

Get the VID and PID of a device.

#### Parameters

[in] <b>device</b>	Handle to a device.
[out] <b>vid</b>	Vendor ID value from Device Descriptor.
[out] <b>pid</b>	Product ID value from Device Descriptor.

#### Returns

USBH\_OK if successful.  
USBH\_ERR\_NOT\_FOUND if device handle is invalid.

#### 2.24.6.18 USBH\_device\_setup\_transfer

```
int32_t USBH_device_setup_transfer ( USBH_device_handle device,
                                      USB_device_request * req,
                                      uint8_t *          buffer,
                                      int16_t            timeout
                                      )
```

Transfer data to/from a USB control endpoint.

USB IN or OUT request is implied from the req parameter. The length of the transfer is implied from the dwLength member of the **USB\_device\_request** structure. For IN transfers, length is the number of bytes to be sent. For OUT transfers, length is the maximum number of bytes to read.

#### Parameters

[in] <b>device</b>	Device to address.
[in] <b>req</b>	USB Device Request to send in SETUP token.

- [in] **buffer**            Appropriately sized buffer for the transfer.
- [in] **timeout**            Number of milliseconds to wait for response.

**Returns**

Number of bytes transferred if successful. (i.e., >= 0)  
USBH\_ERR\_NOT\_FOUND if device handle is invalid.  
USBH\_ERR\_RESOURCES if there are insufficient resources.  
USBH\_ERR\_\* depending on USB bus errors.

**2.24.6.19 USBH\_device\_remote\_wakeup**

```
int8_t USBH_device_remote_wakeup ( USBH_device_handle device,
                                   const uint8_t      request
                                   )
```

Sets or clears a remote wakeup feature request to a device.

Sends a SET\_FEATURE request to a device.

This function is **currently NOT IMPLEMENTED**.

**Parameters**

- [in] **device**            Handle to a device.
- [in] **request**            Set or Clear Port feature. Described in Table 9-4 in Section 9.4 of USB Specification.

**Returns**

USBH\_OK if successful.  
USBH\_ERR\_NOT\_FOUND if device handle is invalid.  
USBH\_ERR\_RESOURCES if there are insufficient resources.  
USBH\_ERR\_\* depending on USB bus errors.

**2.24.6.20 USBH\_device\_set\_configuration**

```
int8_t USBH_device_set_configuration ( USBH_device_handle device,
                                       const uint8_t      conf
                                       )
```

Sets the current configuration value of a device.

Sends a SET\_CONFIGURATION request to a device.

**Note:** Should be done strictly only during enumeration.

**Parameters**

- [in] **device**            Handle to a device.
- [in] **conf**                New configuration value.

**Returns**

USBH\_OK if successful.  
USBH\_ERR\_NOT\_FOUND if the device handle is invalid.  
USBH\_ERR\_RESOURCES if there are insufficient resources.  
USBH\_ERR\_\* depending on USB bus errors.

#### **2.24.6.21 USBH\_get\_interface\_count**

```
int8_t USBH_get_interface_count ( USBH_device_handle device,
                                  uint8_t *          count
                                  )
```

Get interface count.

Get the count of interfaces enumerated for a device.

##### **Parameters**

[in] <b>device</b>	Count interface on this device
[out] <b>count</b>	Number of interfaces on device

##### **Returns**

USBH\_OK if successful.

USBH\_ERR\_NOT\_FOUND if the device handle is invalid.

#### **2.24.6.22 USBH\_get\_interface\_list**

```
int8_t USBH_get_interface_list ( USBH_device_handle device,
                                  USBH_interface_handle * interface
                                  )
```

Get interface list.

Get the first interface of a device. The function will return a handle to the interface if there is one or more interfaces. If there are no interfaces, then a NULL is returned.

##### **Parameters**

[in] <b>device</b>	Handle to a device.
[out] <b>interface</b>	Handle to the first interface.

##### **Returns**

USBH\_OK if successful.

USBH\_ERR\_NOT\_FOUND if device handle is invalid.

#### **2.24.6.23 USBH\_get\_next\_interface**

```
int8_t USBH_get_next_interface ( USBH_interface_handle interface,
                                  USBH_interface_handle * next
                                  )
```

Get next interface in list.

Get the next interface in the list. The function will return a handle to the interface if there are more interfaces. If there are no more interfaces, then a NULL is returned.

##### **Parameters**

[in] <b>interface</b>	Handle to an interface.
[out] <b>next</b>	Handle to the next interface.

**Returns**

USBH\_OK if successful.  
USBH\_ERR\_NOT\_FOUND if interface handle is invalid.

**2.24.6.24 USBH\_interface\_get\_info**

```
int8_t USBH_interface_get_info ( USBH_interface_handle interface,
                                USBH_interface_info *   info
                                )
```

Get interface information.  
Get information of an interface.

**Parameters**

[in] <b>interface</b>	Handle to an interface.
[out] <b>info</b>	Structure to receive interface information.

**Returns**

USBH\_OK if successful.  
USBH\_ERR\_NOT\_FOUND if interface handle is invalid.

**2.24.6.25 USBH\_interface\_get\_class\_info**

```
int8_t USBH_interface_get_class_info ( USBH_interface_handle interface,
                                       uint8_t *             devClass,
                                       uint8_t *             devSubclass,
                                       uint8_t *             devProtocol
                                       )
```

Get interface class, subclass and protocol.  
Get the class information of an interface.

**Parameters**

[in] <b>interface</b>	Handle to an interface.
[out] <b>devClass</b>	USB class value for the interface.
[out] <b>devSubclass</b>	USB subclass value for the interface.
[out] <b>devProtocol</b>	USB protocol value for the interface.

**Returns**

USBH\_OK if successful.  
USBH\_ERR\_NOT\_FOUND if interface handle is invalid.

**2.24.6.26 USBH\_get\_control\_endpoint**

```
int8_t USBH_get_control_endpoint ( USBH_device_handle   device,
                                    USBH_endpoint_handle * endpoint
                                    )
```

Get control endpoint.

Get the control endpoint of a device. The function will return a handle to the control endpoint.

**Parameters**

[in] <b>device</b>	Handle to a device.
[out] <b>endpoint</b>	Handle to a control endpoint.

**Returns**

USBH\_OK if successful.

USBH\_ERR\_NOT\_FOUND if device handle is invalid.

**2.24.6.27 USBH\_get\_endpoint\_count**

```
int8_t USBH_get_endpoint_count ( USBH_interface_handle interface,
                                uint8_t * count
                                )
```

Get endpoint count.

Get the count of endpoints enumerated for an interface.

**Parameters**

[in] <b>interface</b>	Count endpoints on this interface
[out] <b>count</b>	Number of endpoints on interface

**Returns**

USBH\_OK if successful.

USBH\_ERR\_NOT\_FOUND if interface handle is invalid.

**2.24.6.28 USBH\_get\_endpoint\_list**

```
int8_t USBH_get_endpoint_list ( USBH_interface_handle interface,
                                USBH_endpoint_handle * endpoint
                                )
```

Get endpoint list.

Get the first endpoint of an interface. The function will return a handle to the endpoint if there are one or more endpoints. If there are no endpoints, then a NULL is returned.

**Parameters**

[in] <b>interface</b>	Handle to an interface.
[out] <b>next</b>	Handle to first endpoint.

**Returns**

USBH\_OK if successful.

USBH\_ERR\_NOT\_FOUND if interface handle is invalid.

**2.24.6.29 USBH\_get\_next\_endpoint**

```
int8_t USBH_get_next_endpoint ( USBH_endpoint_handle endpoint,
                                USBH_endpoint_handle * next
                                )
```



Get next endpoint in list.

Get the next endpoint in the list. The function will return a handle to the endpoint if there are more endpoints. If there are no more endpoints, then a NULL is returned.

#### Parameters

[in] <b>endpoint</b>	Handle to an endpoint.
[out] <b>next</b>	Handle to next endpoint.

#### Returns

USBH\_OK if successful.  
USBH\_ERR\_NOT\_FOUND if endpoint handle is invalid.

#### 2.24.6.30 USBH\_endpoint\_get\_info

```
int8_t USBH_endpoint_get_info ( USBH_endpoint_handle endpoint,  
                                USBH_endpoint_info *   info  
                                )
```

Get endpoint information.

Get information of an endpoint.

#### Parameters

[in] <b>endpoint</b>	Handle to an endpoint.
[out] <b>info</b>	Structure to receive endpoint information.

#### Returns

USBH\_OK if successful.  
USBH\_ERR\_NOT\_FOUND if endpoint handle is invalid.

#### 2.24.6.31 USBH\_endpoint\_halt

```
int8_t USBH_endpoint_halt ( USBH_endpoint_handle endpoint,  
                             const uint8_t          request  
                             )
```

Sets or clears an endpoint halt feature request to an endpoint.

Sends a SET\_FEATURE request to an endpoint.

#### Parameters

[in] <b>endpoint</b>	Handle to an endpoint.
[in] <b>request</b>	Set or Clear Port feature. Described in Table 9-4 in Section 9.4 of USB Specification.

#### Returns

USBH\_OK if successful.  
USBH\_ERR\_NOT\_FOUND if endpoint handle is invalid.  
USBH\_ERR\_RESOURCES if there are insufficient resources.  
USBH\_ERR\_\* depending on USB bus errors.

**2.24.6.32 USBH\_interface\_clear\_host\_halt**

```
int8_t USBH_interface_clear_host_halt ( USBH_endpoint_handle endpoint )
```

Clear a halted flag on an endpoint in the host controller.

Instruct the USB host controller to remove the halt flag from an endpoint.

**Parameters**

[in] **endpoint** Handle to an endpoint.

**Returns**

USBH\_OK if successful.

USBH\_ERR\_NOT\_FOUND if endpoint handle is invalid.

**2.24.6.33 USBH\_get\_hub\_status**

```
int8_t USBH_get_hub_status ( USBH_device_handle hub,  
                             USB_hub_status * status  
                           )
```

Return status specified hub.

For the hub pointed to by the handle, return the status of the hub. For the root hub, the handle will be NULL.

**Parameters**

[in] **hub** Handle to hub device.

[out] **status** Hub status. As described in Table 11-19 and Table 11-20 of Section 11.24.2.6 in the USB Specification. Status in low word and change in high word.

**Returns**

USBH\_OK on success.

USBH\_ERR\_NOT\_FOUND if hub handle is invalid.

USBH\_ERR\_\* an error occurred when querying a USB hub.

**2.24.6.34 USBH\_get\_hub\_port\_count**

```
int8_t USBH_get_hub_port_count ( USBH_device_handle hub,  
                                 uint8_t * count  
                               )
```

Return number of ports on specified hub.

For the hub pointed to by the handle, return the number of ports that are available. For the root hub, the handle will be NULL.

**Parameters**

[in] **hub** Handle to hub device.

[out] **count** Number of ports on hub.

**Returns**

USBH\_OK on success.

USBH\_ERR\_NOT\_FOUND if hub handle is invalid.

### 2.24.6.35 *USBH\_get\_hub\_port\_status*

```
int8_t USBH_get_hub_port_status ( USBH_device_handle  hub,
                                   const uint8_t        port,
                                   USB_hub_port_status * status
                                   )
```

Return the status of the specified port on the hub.

For the hub pointed to by the handle, return the status of the numbered port. For the root hub, the handle will be NULL.

#### Parameters

[in] <b>hub</b>	Handle to hub device.
[in] <b>port</b>	Port number on hub.
[out] <b>status</b>	Port status. As described in Table 11-21 of Section 11.24.2.7 in the USB Specification.

#### Returns

USBH\_OK on success.

USBH\_ERR\_NOT\_FOUND if hub handle is invalid.

USBH\_ERR\_\* an error occurred when querying a USB hub.

### 2.24.6.36 *USBH\_hub\_set/clear\_feature*

```
int8_t USBH_hub_clear_feature ( USBH_device_handle  hub,
                                const uint16_t        feature
                                )
int8_t USBH_hub_set_feature ( USBH_device_handle  hub,
                              const uint16_t        feature
                              )
```

Set/Clear Feature on hub.

For the hub pointed to by the handle, send a set or clear feature. For the root hub, the handle will be NULL. Set or Clear feature operation described in Section 11.24.2.12 & 11.24.2.1 of the USB Specification.

#### Parameters

[in] <b>hub</b>	Handle to hub device.
[in] <b>feature</b>	Port feature. As described in Table 11-17 of Section 11.24.2 in the USB Specification.

#### Returns

USBH\_OK on success.

USBH\_ERR\_NOT\_FOUND if hub handle is invalid.

USBH\_ERR\_\* an error occurred sending the request to a USB hub.

### 2.24.6.37 *USBH\_hub\_set/clear\_port\_feature*

```
int8_t USBH_hub_set_port_feature ( USBH_device_handle  hub,
```

```

        const uint8_t      port,
        const uint16_t     feature
    )

    int8_t USBH_hub_clear_port_feature ( USBH_device_handle hub,
        const uint8_t      port,
        const uint16_t     feature
    )
  
```

Set/Clear Port Feature on hub.

For the hub pointed to by the handle, send a set or clear port feature. For the root hub, the handle will be NULL. Set or Clear Port feature operation described in Section 11.24.2.13 & 11.24.2.2 of the USB Specification.

#### Parameters

[in] <b>hub</b>	Handle to hub device.
[in] <b>port</b>	Port number on hub.
[in] <b>feature</b>	Port feature. As described in Table 11-17 of Section 11.24.2 in the USB Specification.

#### Returns

USBH\_OK on success.

USBH\_ERR\_NOT\_FOUND if hub handle is invalid.

USBH\_ERR\_\* an error occurred when sending the request to a USB hub.

## 2.25 USB Host Stack Extensions API

The file **ft900\_usbd.h** contains the definitions for the USB host extension functions in the libft900.a library.

API functions for extensions to the USB Host stack. These functions provide additional functionality useful to implement a USB Host application.

### 2.25.1 API Cross Reference

It utilises the following library APIs:

**ft900\_usbh.h** – USB host

Additional definitions are taken from:

**ft900\_usb.h** – General USB definitions

### 2.25.2 Function Documentation

#### 2.25.2.1 *USBHX\_enumerate\_wait*

```
USBH_STATE USBHX_enumerate_wait ( void )
```

Waits for a connection to the root hub and enumerates the device.

Will block until a device is connected to the root hub and then proceed to enumerate it and any downstream devices. Once this is complete, then it will check the enumeration result and return. Will never return USBH\_STATE\_NOTCONNECTED.

## Returns

USBH\_STATE\_CONNECTED - Device is connected but there was a general failure to enumerate.

USBH\_STATE\_ENUMERATED - Device is connected and enumerated properly.

USBH\_STATE\_ENUMERATED\_PARTIAL - Device is connected and enumeration is started.

Enumeration did not complete so some devices, interfaces or endpoints may be missing.

### 2.25.2.2 USBHX\_find\_by\_class

```
int8_t USBHX_find_by_class ( USBH_device_handle *   phDev,
                             USBH_interface_handle * phInterface,
                             uint8_t                usbClass,
                             uint8_t                usbSubclass,
                             uint8_t                usbProtocol
                             )
```

Get interface class, subclass and protocol.

Get the class information of an interface.

## Parameters

[in] <b>interface</b>	Handle to an interface.
[out] <b>class</b>	USB class value for interface.
[out] <b>subclass</b>	USB subclass value for interface.
[out] <b>protocol</b>	USB protocol value for interface.

## Returns

USBH\_OK if successful.

USBH\_ERR\_NOT\_FOUND if interface handle is invalid.

### 2.25.2.3 USBHX\_find\_by\_vid\_pid

```
int8_t USBHX_find_by_vid_pid ( USBH_device_handle * phDev,
                               uint16_t             usbVid,
                               uint16_t             usbPid
                               )
```

Find the first device with a specific VID and PID.

Get the VID and PID of a device.

## Parameters

[in] <b>device</b>	Handle to a device.
[out] <b>vid</b>	Vendor ID value from Device Descriptor.
[out] <b>pid</b>	Product ID value from Device Descriptor.

## Returns

USBH\_OK if successful.

USBH\_ERR\_NOT\_FOUND if device handle is invalid.

#### **2.25.2.4 USBHX\_get\_config\_descriptor**

```
int8_t USBHX_get_config_descriptor ( USBH_device_handle device,
                                     uint8_t type,
                                     uint8_t index,
                                     uint16_t offset,
                                     uint16_t len,
                                     uint8_t * buf
                                     )
```

Get a partial descriptor from a device.

Sends a GET\_DESCRIPTOR request to a device and returns a section of the data.

##### **Parameters**

[in] <b>device</b>	Handle to a device.
[in] <b>type</b>	Configuration descriptor type.
[in] <b>index</b>	Index of descriptor.
[in] <b>offset</b>	Start position in descriptor to read.
[in] <b>len</b>	Number of bytes to read from position "offset".
[in] <b>buf</b>	Location to copy descriptor into (must be minimum size of "len").

##### **Returns**

USBH\_OK if successful.  
USBH\_ERR\_NOT\_FOUND if device handle is invalid.  
USBH\_ERR\_RESOURCES if there are insufficient resources.  
USBH\_ERR\_\* depending on USB bus errors.

#### **2.25.2.5 USBHX\_root\_connected**

```
int8_t USBHX_root_connected ( void )
```

Tests if a device is connected to the root hub.

##### **Returns**

zero - No device connected.  
non-zero - A device is connected but may not be enumerated.

#### **2.25.2.6 USBHX\_root\_enumerated**

```
int8_t USBHX_root_enumerated ( void )
```

Tests if a device is connected to the root hub and enumerated.

##### **Returns**

zero - No device is enumerated.  
non-zero - A device is connected and enumerated. The device can be used with the USBH driver.

#### **2.25.2.7 USBHX\_root\_enumeration\_failed**

```
int8_t USBHX_root_enumeration_failed ( void )
```

Tests if the enumeration worked correctly.

#### Returns

zero - Device(s) enumerated correctly.

non-zero - No device connected, or a device is connected but not enumerated, or the device may have not been enumerated completely.

## 2.26 Startup DFU Feature

The file **ft900\_startup\_dfu.h** contains the definitions for the USB startup DFU device functions in the libft900.a and libft930.a libraries.

The Startup DFU library allows an application to enable the USB device on the FT9xx temporarily to present a DFU interface to the USB host. Software on the USB host can then update the application stored in Flash on the FT9xx regardless of the functionality or features of the existing application.

The feature can be added to any application by adding a call to the function **STARTUP\_DFU**. This call can be made under any conditions – maybe a button press at power-up detected by a GPIO or just unconditionally when the application is started.

The USB interface remains active for a short period of time (~200ms) and once activated by enumeration from the USB host, it will continue to stay active for around 1000ms after activity has ceased.

This file contains Startup DFU feature function definitions, constants and structures which are exposed in the API.

Note that as this is a USB device so all transaction nomenclature is from the point of view from the host. If the device sends data to the host, then it is called an IN transaction. If it receives data from the host, then it is an OUT transaction.

### 2.26.1 API Cross Reference

It utilises the following library APIs:

**ft900\_timers.h** – Timers

**ft900\_sys.h** – Chip Management

**ft900\_interrupt.h** – Interrupt Management

**ft900\_usbd.h** – USB device

Additional definitions are taken from:

**ft900\_usb.h** – General USB definitions

**ft900\_usb\_dfu.h** –USB DFU definitions

### 2.26.2 Macro Definition Documentation

#### 2.26.2.1 **STARTUP\_DFU**

```
#define STARTUP_DFU(...)
```

Macros to overload **startup\_dfu** function. Allows the **STARTUP\_DFU** call to be made with either no parameters or with one parameter. This permits an optional timeout to be passed to the **startup\_dfu()** function.

## 2.26.3 Function Documentation

### 2.26.3.1 *STARTUP\_DFU*

```
void startup_dfu ( int timeout )
```

Temporarily start the USB device with a DFU interface.

When called, the USB device will be enabled for around 200ms allowing a USB host to enumerate the device. Once enumerated, the function will wait for around 1000ms for a DFU connection from the USB host. This will allow a program on the host PC to download new firmware to the device. The function returns after one of the timeouts has completed. If the firmware on the device is updated or the device is reset via a USB reset, then the device will be reset.

#### Parameters

**int timeout** Number of milliseconds to wait until a connection from a host controller is established and a DFU\_DETACH request sent to the device. A value of zero will result in the default to infinite.

## 2.27 SD Host

The file **ft900\_sdhost.h** contains the definitions for the SD card device functions in the libft900.a and libft930.a libraries.

### 2.27.1 Enumeration Type Documentation

#### 2.27.1.1 *sdhost\_cmd\_t*

```
enum sdhost_cmd_t
```

Enumerator
SDHOST_BUS_CMD
SDHOST_APP_SPECIFIC_CMD

#### 2.27.1.2 *sdhost\_response\_t*

```
enum sdhost_response_t
```

Enumerator
SDHOST_RESPONSE_NONE
SDHOST_RESPONSE_R1
SDHOST_RESPONSE_R1b
SDHOST_RESPONSE_R2
SDHOST_RESPONSE_R3
SDHOST_RESPONSE_R4
SDHOST_RESPONSE_R5
SDHOST_RESPONSE_R5b
SDHOST_RESPONSE_R6
SDHOST_RESPONSE_R7



### 2.27.1.3 *SDHOST\_STATUS*

enum SDHOST\_STATUS

Enumerator
SDHOST_OK
SDHOST_ERROR
SDHOST_CARD_INSERTED
SDHOST_CARD_REMOVED
SDHOST_INVALID_RESPONSE_TYPE
SDHOST_CMD_TIMEOUT
SDHOST_UNUSABLE_CARD
SDHOST_CMD2_FAILED
SDHOST_CMD3_FAILED
SDHOST_CMD8_FAILED
SDHOST_CMD9_FAILED
SDHOST_CMD55_FAILED
SDHOST_ACMD41_FAILED
SDHOST_CANNOT_ENTER_TRANSFER_STATE
SDHOST_CANNOT_SET_CARD_BUS_WIDTH
SDHOST_RESPONSE_ERROR
SDHOST_WRITE_ERROR
SDHOST_READ_ERROR

### 2.27.2 Function Documentation

#### 2.27.2.1 *sdhost\_abort*

SDHOST\_STATUS **sdhost\_abort** ( void )

Abort current sdhost operation.

##### **Returns**

SDHOST\_OK if successful.

#### 2.27.2.2 *sdhost\_card\_detect*

SDHOST\_STATUS **sdhost\_card\_detect** ( void )

Check to see if a card is inserted.

##### **Returns**

SDHOST\_CARD\_INSERTED if a card is inserted.

SDHOST\_CARD\_REMOVED if no card is inserted.

### 2.27.2.3 *sdhost\_card\_init*

SDHOST\_STATUS *sdhost\_card\_init* ( void )

Identifies and initializes the inserted card. S  
DHOST can work at baseclock (50Mhz) when the SD card supports it.

#### **Returns**

either SDHOST\_ERROR or SDHOST\_OK

### 2.27.2.4 *sdhost\_init*

void *sdhost\_init* ( void )

Function initializes SD Host device.

### 2.27.2.5 *sdhost\_sys\_init*

void *sdhost\_sys\_init* ( void )

Function used for initializing system registers.

### 2.27.2.6 *sdhost\_transfer\_data*

```
SDHOST_STATUS sdhost_transfer_data ( uint8_t  direction,  
                                       void *   buf,  
                                       uint32_t  numBytes,  
                                       uint32_t  addr  
                                       )
```

Transfer data to/from SD card.

#### **Parameters**

<b>direction</b>	SDHOST_READ or SDHOST_WRITE
<b>buf</b>	Address of memory data to be read or written
<b>numBytes</b>	Size of data to be read or written
<b>addr</b>	Address of SD card to write to or read from

#### **Returns**

SDHOST\_STATUS enum indicating on outcome of operation.

## 2.28 Datalogger Feature

FT9XX provides several peripherals which may be interfaced to output or storage devices. Developers may use any of these peripherals to output debug or diagnostic information during development. Peripherals attached to storage (SPI flash, SD Card memory, USB Mass Storage, etc.) may be used to store such information too. However, there are customer applications in which no external storage is available, and it becomes impossible to capture and store debug or diagnostic information collected in the field. The datalogger feature uses the on-chip flash in the FT9XX for such storage.

FT90X has 256KB of flash. The flash is organized as multiples of blocks. Blocks are made up of sectors and sectors in turn are made up of pages. The smallest programmable unit is a page, and the smallest erasable unit is a sector. The following table describes the flash geometry in FT90X.

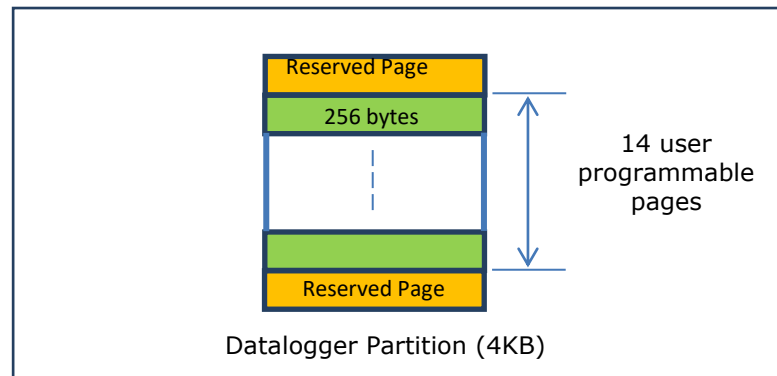
Memory Organization	Multiples	Units	Size
Complete Flash	4	Blocks	256 KB
Block	16	Sectors	64 KB
Sector	16	Page	4 KB
Page	256	Bytes	256 B

**Table 2 - FT90X Flash Geometry**

### 2.28.1 Datalogger Partition

The datalogger partition occupies one sector of the flash and is 4KB in size. As mentioned in Table 2 - FT90X Flash Geometry, there are 16 pages in one sector. The first and last pages are reserved, and the remaining 14 pages are available to the user application for usage. User application refers to the 14 pages via page index 0 to 13.

Once a page has been programmed, it may not be programmed again. In order to overwrite a previously programmed page, the partition has to be erased.



**Figure 2.1 - Datalogger Partition**

### 2.28.2 API Cross Reference

It utilizes the following libraries:

**ft900\_memctl.h**– FT9xx memory controller driver

The file **ft900\_dlog.h** contains the definitions for the datalogger feature functions in the libft900.a and libft930.a libraries.

### 2.28.3 Variable Documentation

#### 2.28.3.1 \_\_dlog\_partition

```
extern __flash__ uint32_t __dlog_partition[ ];
```

The global variable `__dlog_partition` has to be referenced in the user application through an extern. The `__dlog_partition` variable is defined in the C runtime for a datalogger application. This value is passed to the `dlog_init()` API function. The `__flash__` attribute informs the compiler that this is a pointer to flash memory.

### 2.28.4 Function Documentation

#### 2.28.4.1 dlog\_init

```
int dlog_init ( __flash__ uint32_t *flashbuf,
               int                *pgsz,
```

```
int          pages,  
    )
```

**dlog\_init** must be the first function to be called to initialize the datalogger API. Set **flashbuf** to **\_\_dlog\_partition**. On successful return, **pgsz** and **pages** shall be initialized. **Pgsz** indicates the size of the page in flash and **pages** indicates the number of pages available in the partition. In the present API, **pgsz** is fixed at 256 bytes and **pages** is fixed at 14.

**dlog\_init** does not keep track of which pages were programmed and which pages remain erased. Such page management is left to the user application.

#### Parameters

<b>flashbuf</b>	Pointer to flash datalog partition
<b>pgsz</b>	Size of page on flash
<b>pages</b>	Number of pages in partition, pg=1...n pages

#### Returns

On success a 0, otherwise -1 if partition is invalid.

#### 2.28.4.2 dlog\_erase

```
int dlog_erase ( void )
```

This function is used to erase the flash partition. It then programs the first and last pages with the datalogger signature.

#### Returns

0 when datalog partition is erased, otherwise -1 if datalog library has not been initialized.

#### 2.28.4.3 dlog\_read

```
int dlog_read ( int      pg,  
                uint32_t *data,  
                )
```

**dlog\_read** is used to read pages from the datalogger partition. **Pg** is an input argument and denotes the user page number to read. Valid values for **pg** are 0 to 13. **data** is a 32-bit output pointer into which page content is transferred.

#### Parameters

<b>pg</b>	Page number, valid range 0..13
<b>data</b>	32-bit pointer to buffer of page size length

#### Returns

On success a 0, otherwise -1 if page or data is invalid.

#### 2.28.4.4 dlog\_prog

```
int dlog_prog ( int      pg,  
                uint32_t *data,  
                )
```

**dlog\_prog** is used to program pages with user data. **Pg** is an input argument and denotes the user page number to program. Valid values for **pg** are 0 to 13. No check is made if a page was

previously programmed. **data** is a 32-bit input pointer containing the information to be programmed.

#### Parameters

<b>pg</b>	Page number, valid range 0..13
<b>data</b>	32-bit pointer to buffer of page size length

#### Returns

On success a 0, otherwise -1 if page or data is invalid.

## 2.29 D2XX Feature

The D2XX interface is a proprietary interface specifically for FTDI devices. A D2XX channel connects two processes: the D2XX application on the USB Host and the user application executing on the FT9xx. Data is exchanged transparently between the peer applications at each end of the channel. It relieves the user firmware from dealing with any USB related communication.

The functions are provided by the pre-compiled library **libft900\_d2xx\_dev.a** for FT90X and **libft930\_d2xx\_dev.a** for FT93X.

D2XX library API calls for the purpose are:

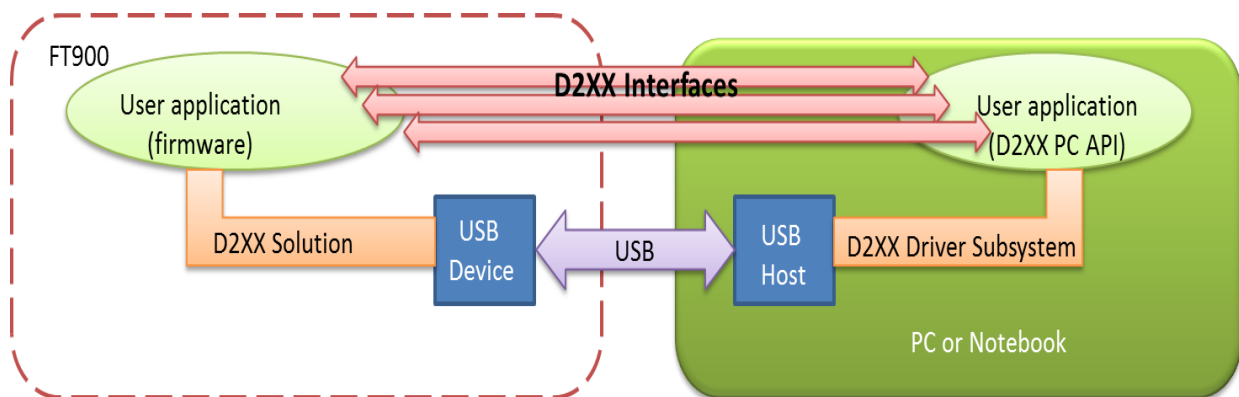
D2XX\_Init() – To provide user configuration and initialize the D2XX Solution library.

D2XX\_Exit() – To exit D2XX mode and USB device is released to the system.

D2XX\_Read() – A read returns data from the D2XX channel. If the channel is empty, zero bytes are returned.

D2XX\_Write() – A write loads data into the D2XX channel. If the channel is full, the data is not accepted into the channel.

D2XX\_IOCTL() – Can be used for remote wakeup or interface related controls.



**Figure 2.2 - D2XX Solution Context Diagram**

### 2.29.1 API Cross Reference

It utilises the following library APIs:

**ft900\_sys.h** – Chip Management

**ft900\_interrupt.h** – Interrupt Management

**ft900\_usbd.h** – USB device API

Additional definitions are taken from

**ft900\_usb.h** – General USB definitions

## ft900\_usb\_dfu.h – USB DFU class definitions

### 2.29.2 Macro Definition Documentation

#define D2XX\_MAX\_INTERFACES (3) [FT90x]

#define D2XX\_MAX\_INTERFACES (7) [FT93x]

The maximum number of D2XX interfaces that the D2XX solution for FT9xx can support.

#define D2XX\_MAX\_DESCRIPTOR\_STRING\_SIZE (128)

The maximum total length of all the four strings used in the string descriptors. Refer to TD2XX\_DeviceConfiguration for details on the strings used.

#define D2XX\_DEVICEGUID\_STRING\_SIZE (40)

Double Null terminated ASCII string for Unique device interface GUID in registry format (including Braces and hyphen) E.g.: {2C69C451-55E9-46f0-8E4E-1F30D1E148EE}.

#define D2XX\_API\_ERR\_BASE (-1)

A non-zero, negative, number base to start the error coding for the Enum ED2XX\_ErrorCode.

### 2.29.3 Typedef Documentation

#### 2.29.3.1 FD2XX\_Callback

typedef void (\*FD2XX\_Callback)(ED2XX\_EventCode eventID, void \*ref, void\* param1, void\* param2);

Callback declaration for user callback functions invoked from D2XX solution.

#### Parameters

[in] eventID	The events for which the D2XX provides callback
[in] ref	User application context which is stored and given back during invocation of callback functions on events.
[in] param1	In the case of D2XX_EVT_SUSPEND, this PARAM indicates whether the RemoteWakeup is enabled or not.  1 – Enabled 0 – Disabled  Based on this, the user application can issue a Remote Wakeup to the host device in Suspend mode.
[in] param2	Currently unused.

### 2.29.4 Enumeration Type Documentation

#### 2.29.4.1 ED2XX\_ErrorCode

The return values returned by the API functions.

D2XX_ERR_NONE = 0	Returns Success
D2XX_ERR_IO = D2XX_API_ERR_BASE	IO operation error
D2XX_ERR_MULTIPLE = D2XX_API_ERR_BASE-1	Multiple call of the init or exit API
D2XX_ERR_DEVICE = D2XX_API_ERR_BASE-2	Device error
D2XX_ERR_INSUFFICIENT_RESOURCES = D2XX_API_ERR_BASE-3	Insufficient memory or resources
D2XX_ERR_INVALID_PARAMETER = D2XX_API_ERR_BASE-4	Invalid Parameter supplied to API function
D2XX_ERR_NOT_SUPPORTED = D2XX_API_ERR_BASE-5	Operation not supported

D2XX\_ERR\_CHECKSUM\_FAILED = D2XX\_API\_ERR\_BASE-6

Configuration checksum failed

#### 2.29.4.2 *ED2XX\_EventCode*

The events for which the D2XX API provides callback.

D2XX_EVT_SUSPEND	SUSPEND EVENT from USB Host
D2XX_EVT_RESUME	RESUME EVENT from USB Host
D2XX_EVT_BUS_RESET	BUS RESET EVENT from USB Host
D2XX_EVT_READY	D2XX enters Ready state where READ/WRITE requests are processed
D2XX_EVT_UNREADY	D2XX exits Ready state (USB disconnected)
D2XX_EVT_DFU_DETACH	DFU DETACH Class command from DFU application
D2XX_EVT_TESTMODE	D2XX enters Test Mode. Exit is via power cycle
D2XX_EVT_INTF_RESET	D2XX interface reset command to clear the channel
D2XX_EVT_MAX_CODE	End of List.

#### 2.29.4.3 *ED2XX\_IoctlID*

The ioctl id is the unique identifier used by the D2XX IOCTL API to process the ioctl request.

D2XX_IOCTL_SYS_REMOTE_WAKEUP	REMOTE WAKEUP to the USB Host
D2XX_IOCTL_INTERFACE_WAKEUP	D2XX interface wakeup to be sent for a D2XX interface
D2XX_IOCTL_MAX_ID	End of IOCTL ID List

#### 2.29.4.4 *ED2XX\_TransferSize*

The maximum packet size for which transfer happens on the D2XX interface.

D2XX_XFER_SIZE_32 = 32	32 Bytes
D2XX_XFER_SIZE_64 = 64	64 Bytes
D2XX_XFER_SIZE_128 = 128	128 Bytes
D2XX_XFER_SIZE_256 = 256	256 Bytes
D2XX_XFER_SIZE_512 = 512	512 Bytes
D2XX_XFER_SIZE_1024 = 1024	1024 Bytes

### 2.29.5 Structure Documentation

#### 2.29.5.1 *TproductDescriptors*

Struct to provide the product specific information about D2XX USB device.

##### Fields:

uint16_t VendorID	Vendor ID (assigned by the USB-IF)
uint16_t ProductID	Product ID (assigned by the manufacturer)

### 2.29.5.2 TconfigDescriptors

Struct to provide the configuration descriptor information about D2XX USB device.

#### Fields:

uint8_t BCDEnable	Battery Charge Detection to be enabled or not. 0=disable, 1=enable
uint8_t DFUCapable	DFU support. 0=disable, 1=enable
uint8_t SelfPowered	Bus or Self Powered Device. 0=disable, 1=enable
uint8_t MaxPower	Maximum power consumption of the USB device from the bus in this specific configuration when the device is fully operational. Expressed in 2 mA units (i.e., 50 = 100 mA).
UInt8_t NumOfD2XXInterfaces	Number of D2XX interfaces supported by this USB configuration. Range: 1 to D2XX_MAX_INTERFACES
uint8_t RMWKUPEnable	Remote Wakeup capable or not. 0=disable, 1=enable
uint16_t MaxTransferSize	The maximum packet size for which transfer happens on each of the D2XX interfaces. Value: 0 or enum values defined in ED2XX_TransferSize. Fill the value to 0 if a d2xx interface is not used (i.e., Indexes >= NumOfD2XXInterfaces)

### 2.29.5.3 TD2XX\_DeviceConfiguration

#### Fields:

uint32_t Signature	Signature of the D2XX configuration. This must be 0xF7D1DCF6 to be recognized by the library.
uint16_t ConfigVersion	Version number of this configuration structure.
uint16_t DelayAfterPHYEn	Delay after USB PHY is enabled.
TproductDescriptors ProductDesc	Struct to provide the product specific information about D2XX USB device.
TconfigDescriptors ConfigDesc	Struct to provide the configuration descriptor information about D2XX USB device.
uint8_t Strings	String configuration section. String 1 – ASCII string detailing the manufacturer. String 2 – ASCII string detailing the Product. String 3 – ASCII string for the Serial Number. String 4 – ASCII string for the DFU Runtime Interface Name.

#### Note:

All the strings should be preceded with the data length of the string. For e.g.

```
0x07,'B','R','T','C','h','i','p',
0x0A,'F','T','9','0','0',' ','D','2','X','X',
0x0B,'F','T','9','0','0','S','e','r','i','a','l',
0x03,'D','F','U',
```

uint8_t DfuDeviceInterfaceGUID	Double null-terminated ascii string for Unique device interface GUID in registry format (including Braces and hyphen). e.g. {2C69C451-55E9-46f0-8E4E-1F30D1E148EE}
--------------------------------	---



uint16\_t Checksum

16-bit XOR Checksum of the  
 TD2XX\_DeviceConfiguration structure

## 2.29.6 Function Documentation

### 2.29.6.1 D2XX\_Init

ED2XX\_ErrorCode D2XX\_Init(TD2XX\_DeviceConfiguration \*d2xxDeviceConfig, FD2XX\_Callback callbackFn, void \*ref)

Initialises the D2XX solution library. This function MUST be called prior to any further call to the USB functions.

#### Important Integration Notes:

The D2XX library uses Timer D for scheduling its internal process with a clock prescaler set to 1000. Only the remaining hardware timers – Timer A, Timer B and Timer C are available to the user for the application and these timers have to be initialized to the same prescaler value of 1000.

As Timer D is used in the D2XX library, the Timer and the Watchdog hardware block is already enabled in the library through the function call - sys\_enable(sys\_device\_timer\_wdt). The API call of sys\_enable(sys\_device\_timer\_wdt) cannot be called by the user after D2XX\_Init(), as this would affect the D2XX functionality.

#### Parameters

[in] d2xxDeviceConfig	User application's custom specific information about the D2XX USB device and its interfaces. This data is used in the construction of device, config and string descriptors.  It is a pointer to a TD2XX_DeviceConfiguration structure in main memory, not program memory.
[in] callbackFn	The user application registers its callback function through this param.
[in] ref	The user application registers its callback context through this param.

#### Returns

D2XX\_ERR\_NONE if successful.

D2XX\_ERR\_INVALID\_PARAMETER if invalid values or ranges provided through the d2xxDeviceConfig param.

### 2.29.6.2 D2XX\_Exit

void D2XX\_Exit(void)

The application calls this function to exit D2XX mode. This function cleans up the D2XX solution and USB Driver.

### 2.29.6.3 D2XX\_Read

int32\_t D2XX\_Read(int32\_t interfaceNum, uint8\_t \*readBuffer, const int32\_t length)

Performs Read on a D2XX interface.

#### Parameters

[in] interfaceNum	D2XX Interface Number Range: 1..n where n is Number of D2XX Interfaces configured by the application
[in] readBuffer	A pointer to the buffer which the stream data is read into.
[in] length	The number of bytes of data to read from D2XX interface buffer.

**Returns**

Returns the actual number of bytes read from the D2XX interface.

Zero bytes are returned if the internal D2XX buffer is empty.

D2XX\_ERR\_INVALID\_PARAMETER if invalid values or ranges are provided through the interfaceNum or readBuffer params.

D2XX\_ERR\_IO if unsuccessful.

D2XX\_ERR\_DEVICE if the D2XX is not in the request processing state.

**2.29.6.4 D2XX\_Write**

```
int32_t D2XX_Write(int32_t interfaceNum, uint8_t *writeBuffer, const int32_t length)
```

Performs Write on a D2XX interface.

**Parameters**

[in]	interfaceNum	D2XX Interface Number Range: 1..n where n is Number of D2XX Interfaces configured by the application
[in,out]	writeBuffer	A pointer to the buffer to which the stream data is written.
[in]	length	The number of bytes of data to write from user buffer to the D2XX interface.

**Returns**

Returns the actual number of bytes written to the D2XX interface.

Zero bytes are returned if the internal D2XX buffer is full. D2XX\_ERR\_INVALID\_PARAMETER if invalid values or ranges are provided through the interfaceNum or writeBuffer params.

D2XX\_ERR\_IO if unsuccessful.

D2XX\_ERR\_DEVICE if the D2XX is not in the request processing state.

**2.29.6.5 D2XX\_IOCTL**

```
ED2XX_ErrorCode D2XX_IOCTL(int32_t interfaceNum, int ioctlID, void *param1, void *param2)
```

The ioctl API is a catch-all that can handle transactions where read and write are not suitable. Typically, this means control data for a D2XX interface or system control of USB device.

**Parameters**

[in]	interfaceNum	D2XX Interface Number Value: 0-- System Purpose (e.g., Remote Wakeup) or 1..n where n is Number of D2XX Interfaces configured by the application.
[in]	ioctlID	D2XX IOCTL ID. Refer to ED2XX_IoctlID documentation
[in]	param1	Additional parameter that the application passes for D2XX_IOCTL_INTERFACE_WAKEUP. The parameter will either set or clear the wakeup setting in the D2XX interface. It is passed as follows: 1 -> Set Wakeup 0 -> Clear Wakeup
[in]	param2	Currently unused.

**Returns**

D2XX\_ERR\_NONE if successful.

D2XX\_ERR\_INVALID\_PARAMETER if invalid values or ranges provided through the interfaceNum or ioctlID params.

D2XX\_ERR\_DEVICE if the D2XX is not in the request processing state.

D2XX\_ERR\_NOT\_SUPPORTED if any unsupported IOCTL request is made.

## 2.30 FT devices on USB host stack API (ft900\_usbh\_ft.h)

The file ft900\_usbh\_ft.h contains the API functions for enumerating FT devices on USB Host stack. These functions provide additional functionality useful to implement a USB Host application.

The functions are provided by the pre-compiled library **libftd2xx\_host.a**.

### 2.30.1 API Cross Reference

It utilizes the following libraries:

**ft900\_usbh.h** – USB host

### 2.30.2 Structure Documentation

#### 2.30.2.1 USBH\_FT232\_context

Holds a context structure required by each instance of the FT232 driver.

USBH_device_handle hDevice	Handle to the FT232 device. There may be multiple FT232 interfaces on the same devices.
USBH_interface_handle hDataInterface	Interface handles for FT232 DATA interface.
USBH_endpoint_handle hDataEpIn	IN Endpoint handle for the FT232 DATA interfaces.
USBH_endpoint_handle hDataEpOut	OUT Endpoint handle for the FT232 DATA interfaces.
uint16_t bcdDev	bcdDevice from the Device Descriptor. Used to work out the type of FT232 device user is connected to.
uint8_t dataInterfaceNumber	Interface number for data interface. These are used in SETUP requests to identify the correct interface.
int8_t recvStatus	Last status of FT232 DATA IN endpoint poll from USB Host driver
uint32_t recvPacket	Buffer to receive data from USB Host driver. This is exactly one MaxPacket size buffer. It must be of type uint32_t to follow alignment requirements of data buffers in USB Host driver. <b>Note:</b> Can be of type uint8_t if it is qualified with attribute ((aligned (4)))
uint8_t recvBuffer	Circular buffer used to group the packet data from USB Host. This does not have any alignment issues.
uint16_t recvBufferWrite	Read pointers for circular buffer.
uint16_t recvBufferRead	Write pointers for circular buffer.
uint16_t recvBufferAvail	Avail pointers for circular buffer.
uint16_t lastModemStatus	Modem status and line status from the device. The least significant byte of the modemstat parameter holds the modem status. The line status is in the most significant byte.

### 2.30.3 Functions

#### 2.30.3.1 USBH\_FT232\_init

int8\_t USBH\_FT232\_init (USBH\_interface\_handle hInterface, uint8\_t flags, USBH\_FT232\_context \*ctx)

Initialises the FT232 driver. Set up a context for the FT232 driver to use the interface and settings provided in the call.

**Parameters**

USBH_interface_handle hInterface	Handle to the FT232 interface to use.
uint8_t flags	None.
USBH_FT232_context * ctx	Structure instantiated in the application to hold the context information for this instance of the driver.

**Returns**

USBH\_FT232\_OK if successful.

**2.30.3.2 USBH\_FT232\_read**

int32\_t USBH\_FT232\_read (USBH\_FT232\_context \*ctx, uint8\_t \*buffer, size\_t len)

Reads a block of data from the FT232 device DATA interface. The data is buffered internally in the driver as it is produced by the FT232 device and polled by the USB host. The buffer is designed to discard incoming data if the internal buffer fills. Care must therefore be taken to ensure an adequate consumption rate of data from the FT232 device.

**Parameters**

USBH_FT232_context * ctx	Context information for this instance of the driver.
uint8_t * buffer	Receiving buffer.
size_t len	Maximum length of data to read.

**Returns**

Number of bytes transferred to the receiving buffer. This may be less than the amount requested if insufficient data has been received from the CDC device.

**2.30.3.3 USBH\_FT232\_write**

int32\_t USBH\_FT232\_write (USBH\_FT232\_context \*ctx, uint8\_t \*buffer, size\_t len)

Writes a block of data to the CDC device DATA interface. Data is written immediately to the device without buffering.

**Parameters**

USBH_FT232_context * ctx	Context information for this instance of the driver.
uint8_t * buffer	Transmission buffer.
size_t len	Maximum length of data to write.

**Returns**

Number of bytes transferred from the transmission buffer to the device.

**2.30.3.4 USBH\_FT232\_set\_baud\_rate**

int8\_t USBH\_FT232\_set\_baud\_rate (USBH\_FT232\_context \*ctx, uint32\_t baud)

Sets FT232 Baud Rate. The baud rate is passed as a uint32\_t and the routine work out the divisor and sub-integer prescalar required. Refer to:  
[http://www.ftdichip.com/Support/Documents/AppNotes/AN232B-05\\_BaudRates.pdf](http://www.ftdichip.com/Support/Documents/AppNotes/AN232B-05_BaudRates.pdf). It doesn't check if the baud rate can be calculated within the +/- 3% required to ensure a stable link.

**Parameters**

USBH_FT232_context * ctx	Context information for this instance of the driver.
uint32_t baud	Requested baud rate.

**Returns**

USBH\_FT232\_OK if the interface supports the COMM Feature requests.

USBH\_FT232\_ERR\_CLASS if it does not support it.

**2.30.3.5 USBH\_FT232\_set\_flow\_control**

int8\_t USBH\_FT232\_set\_flow\_control (USBH\_FT232\_context \*ctx, uint16\_t mode)

Sets FT232 Flow Control. Flow control can be set as CTS/RTS, DTR/DSR or None.

**Parameters**

USBH_FT232_context * ctx	Context information for this instance of the driver.
uint16_t mode	Flow control mode required. Can be one of the following: zero for none, or USB_FT232_SETFLOWCTRL_RTS_CTS or USB_FT232_SETFLOWCTRL_DTR_DSR.

**Returns**

USBH\_FT232\_OK if the interface supports the COMM Feature requests.

USBH\_FT232\_ERR\_CLASS if the interface does not support it.

**2.30.3.6 USBH\_FT232\_set\_modem\_control**

int8\_t USBH\_FT232\_set\_modem\_control (USBH\_FT232\_context \*ctx, uint16\_t mode, uint8\_t assert)

Sets FT232 Modem Control. Enable RTS, DTR signals for use with flow control and set their current state.

**Parameters**

USBH_FT232_context * ctx	Context information for this instance of the driver.
uint16_t mode	Flow control mode: USB_FT232_SETFLOWCTRL_RTS_CTS or USB_FT232_SETFLOWCTRL_DTR_DSR
uint8_t assert	To set or clear RTS or DTR control signals according to the flow control selected. Value 1 to set RTS or DTR. Value 0 to clear RTS or DTR.

**Returns**

USBH\_FT232\_OK if the interface supports the COMM Feature requests.

USBH\_FT232\_ERR\_CLASS - if the interface does not support it.

**2.30.3.7 USBH\_FT232\_set\_data**

int8\_t USBH\_FT232\_set\_data (USBH\_FT232\_context \*ctx, uint16\_t bits, uint16\_t parity, uint16\_t stop)

Sets FT232 Data Format. Data format sets the number of data bits, stop bits and parity mode used.

**Parameters**

USBH_FT232_context * ctx	Context information for this instance of the driver.
uint16_t bits	Can be either USB_FT232_SETDATA_7_BIT or USB_FT232_SETDATA_8_BIT
uint16_t parity	Can be one of the following: USB_FT232_SETDATA_NOPAR, USB_FT232_SETDATA_ODDPAR, USB_FT232_SETDATA_EVENPAR,

uint16\_t stop

USB\_FT232\_SETDATA\_MARKPAR,  
USB\_FT232\_SETDATA\_SPACEPAR.

Number of stop bits. Can be:  
USB\_FT232\_SETDATA\_1\_STOP or  
USB\_FT232\_SETDATA\_2\_STOP.

**Returns**

USBH\_FT232\_OK if the interface supports the COMM Feature requests.  
USBH\_FT232\_ERR\_CLASS if the interface does not support it.

**2.30.3.8 USBH\_FT232\_set\_latency**

int8\_t USBH\_FT232\_set\_latency (USBH\_FT232\_context \*ctx, uint16\_t latency)

Sets FT232 Latency Timer. Latency timer can be set from 2 upwards.

**Parameters:**

USBH\_FT232\_context \* ctx    Context information for this instance of the driver.  
uint16\_t latency              Number of frames between reporting by FT232 device.

**Returns:**

USBH\_FT232\_OK if the interface supports the COMM Feature requests.  
USBH\_FT232\_ERR\_CLASS if the interface does not support it.

**2.30.3.9 USBH\_FT232\_get\_poll\_status**

void USBH\_FT232\_get\_poll\_status (USBH\_FT232\_context \*ctx, int8\_t \*data\_status)

Returns the last USB Host statuses for endpoint polling. Each time an endpoint is polled, the status is stored. The data IN endpoint values are stored and can be queried by this function.

**Parameters**

USBH\_FT232\_context \* ctx    Context information for this instance of the driver.  
int8\_t \* data\_status          Pointer to receive status of data endpoint polling.

**Returns**

None

**2.30.3.10 USBH\_FT232\_get\_latency**

int8\_t USBH\_FT232\_get\_latency (USBH\_FT232\_context \*ctx, uint16\_t \*latency)

Get the current value of FT232 latency timer, in milliseconds. Value will range from a minimum value of 1.

**Parameters**

USBH\_FT232\_context \* ctx    Context information for this instance of the driver.  
uint16\_t \* latency            Number of frames between reporting by FT232 device.

**Returns**

USBH\_FT232\_OK if the interface supports the COMM Feature requests.  
USBH\_FT232\_ERR\_CLASS if the interface does not support it.

**2.30.3.11 USBH\_FT232\_get\_modemstat**

int8\_t USBH\_FT232\_get\_modemstat (USBH\_FT232\_context \*ctx, uint16\_t \*modemstat)

Gets the modem status and line status from the device. The least significant byte of the modemstat parameter holds the modem status. The line status is held in most significant byte. The modem status is bit-mapped as follows:

Clear To Send (CTS) = 0x10,  
Data Set Ready (DSR) = 0x20,  
Ring Indicator (RI) = 0x40,  
Data Carrier Detect (DCD) = 0x80.

The line status is bit-mapped as follows: Overrun Error (OE) = 0x02, Parity Error (PE) = 0x04, Framing Error (FE) = 0x08, Break Interrupt (BI) = 0x10.

**Parameters**

USBH_FT232_context * ctx	Context information for this instance of the driver.
uint16_t * modemstat	Pointer to a variable which receives the modem status and line status from the device.

**Returns**

USBH\_FT232\_OK if the interface supports the COMM Feature requests.

USBH\_FT232\_ERR\_CLASS if the interface does not support it.

**2.30.3.12 USBH\_FT232\_eeprom\_read**

int8\_t USBH\_FT232\_eeprom\_read (USBH\_FT232\_context \*ctx, uint16\_t e2address, uint16\_t \*e2data)

Read a value from an EEPROM location. EEPROMs for FTDI devices are organized by WORD, so each value returned is 16-bits wide.

**Parameters**

USBH_FT232_context * ctx	Context information for this instance of the driver.
uint16_t e2address	EEPROM location to read from.
uint16_t * e2data	Pointer to the WORD value read from the EEPROM.

**Returns:**

USBH\_FT232\_OK if the interface supports the COMM Feature requests.

USBH\_FT232\_ERR\_CLASS if the interface does not support it.

## 3 Layered Drivers

Several layered drivers have been split from the hardware library in the v2.7.0 release. This was done since these are commonly modified by users and require positive action to modify the versions in the hardware library.

The source code for these has been moved from the hardware library %FT9XX\_TOOLCHAIN%\hardware to a new directory called %FT9XX\_TOOLCHAIN%\drivers.

The source code and header files can be copied to the user's code and be compiled with that. There are tools within the Eclipse build environment to make this easier.

### 3.1 HID Devices on USB Host Stack API

The file **ft900\_usbh\_hid.h** contains the definitions for the USB host HID functions in the libft900.a library.

API functions for USB Host HID devices. These functions provide functionality required to communicate with a HID device through the USB Host interface.

Please refer to the documentation produced by the USB-IF covering HID devices including the Device Class Definition for HID 1.11.

#### 3.1.1 API Cross Reference

It utilises the following library APIs:

**ft900\_delay.h** – Delay

**ft900\_usbh.h** – USB host

Additional definitions are taken from:

**ft900\_usb.h** – General USB definitions

**ft900\_usb\_hid.h** –USB HID definitions

#### 3.1.2 Structure Documentation

##### 3.1.2.1 USBH\_HID\_context

HID device context.

Holds a context structure required by each instance of the driver.

##### Data Fields

USBH_device_handle	hHIDDevice
USBH_interface_handle	hHIDInterface
uint8_t	hidInterfaceNumber
USBH_endpoint_handle	hHIDEpIn
USBH_endpoint_handle	hHIDEpOut
uint8_t	reportInSize
uint8_t	reportOutSize



## Field Documentation

`hHIDDevice`

USB host device handle for HID device.

`hHIDInterface`

USB host interface handle for HID device.

`hidInterfaceNumber`

Interface number for HID device.

`hHIDEpIn`

Handle for IN endpoint used by HID device.

`hHIDEpOut`

Handle for OUT endpoint used by HID device.

`reportInSize`

Report size in bytes for IN reports.

`reportOutSize`

Report size in bytes for OUT reports.

## 3.1.3 Function Documentation

### 3.1.3.1 *USBH\_HID\_init*

```
int8_t USBH_HID_init ( USBH_device_handle  hHIDDev,
                      USBH_interface_handle hHIDInterface,
                      USBH_HID_context *   ctx
                      )
```

Initialise HID device.

Initialises the instance of the HID device and stores information in the **USBH\_HID\_context** structure passed from the application. This allows individual instances of the HID device to be accessed independently.

#### Parameters

- |                           |  |
|---------------------------|--|
| [in] <b>hHIDDev</b>       | Handle of HID device on USB bus.   |
| [in] <b>hHIDInterface</b> | Handle of interface on hHIDDev to use for driver.<br>There may be more than one HID interface on a device. |
| [out] <b>ctx</b>          | Pointer to HID context.  |

#### Returns

Zero if successful, non-zero if not.

**3.1.3.2 USBH\_HID\_get\_report\_size\_in**

```
int8_t USBH_HID_get_report_size_in ( USBH_HID_context * ctx )
```

Gets the IN report size for the HID device.

Allows the application to discover the size of reports sent by the HID device.

**Parameters**

[in] **ctx** Pointer to HID context.

**Returns**

Zero if fail, non-zero for report size.

**3.1.3.3 USBH\_HID\_get\_report\_size\_out**

```
int8_t USBH_HID_get_report_size_out ( USBH_HID_context * ctx )
```

Gets the OUT report size for the HID device.

Allows the application to discover the size of reports to send to the HID device.

**Parameters**

[in] **ctx** Pointer to HID context.

**Returns**

Zero if fail, non-zero for report size.

**3.1.3.4 USBH\_HID\_set\_idle**

```
int8_t USBH_HID_set_idle ( USBH_HID_context * ctx,  
                           uint16_t idle  
                           )
```

Send a SET IDLE request to the HID device.

Forms and sends a SET IDLE request to the control endpoint of the HID device. The interface number of the HID interface is included to tell the device which of possible multiple interfaces to idle.

**Parameters**

[in] **ctx** Pointer to HID context.

[in] **idle** Timeout for idle, zero is infinite.

**Returns**

Zero if successful, non-zero if not.

**3.1.3.5 USBH\_HID\_get\_report**

```
int8_t USBH_HID_get_report ( USBH_HID_context * ctx,  
                             uint8_t * buffer  
                             )
```

Gets an IN report from the HID device.

Returns a report from the device's IN endpoint into the buffer pointed to in the parameters. The buffer must be large enough for the number of bytes returned in **USBH\_HID\_get\_report\_size\_in()**.

**Parameters**

[in] **ctx** Pointer to HID context.  
[out] **buffer** Buffer to receive data.

**Returns**

Zero if successful, non-zero if not.

**3.1.3.6 USBH\_HID\_set\_report**

```
int8_t USBH_HID_set_report ( USBH_HID_context * ctx,  
                             uint8_t *          buffer  
                             )
```

Sends an OUT report to the HID device.

Transmits a report to the device's OUT endpoint from the buffer pointed to in the parameters. The buffer must contain at least the number of bytes returned in **USBH\_HID\_get\_report\_size\_out()**.

**Parameters**

[in] **ctx** Pointer to HID context.  
[out] **buffer** Buffer providing data.

**Returns**

Zero if successful, non-zero if not.

## 3.2 BOMS Devices on USB Host Stack API

The file **ft900\_usbh\_boms.h** contains the definitions for the USB host BOMS functions in the libft900.a library.

API functions for USB Host BOMS devices. These functions provide functionality required to communicate with a BOMS device through the USB Host interface.

Please refer to the documentation produced by the USB-IF covering BOMS devices including the Mass Storage Bulk Only 1.0 specification.

**3.2.1 API Cross Reference**

It utilises the following library APIs:

**ft900\_delay.h** – Delay

**ft900\_usbh.h** – USB host

**ft900\_usbhx.h** – USB host extensions

Additional definitions are taken from:

**ft900\_usb.h** – General USB definitions

**ft900\_usb\_boms.h** –USB BOMS definitions

### 3.2.2 Macro Definition Documentation

#### 3.2.2.1 Block Size

```
#define USBH_BOMS_BLOCK_SIZE 512
```

Defines the size of a sector on the BOMS device used by this library. This can be 512 bytes or 2 kB according to the Bulk Only Mass Storage specification. Only 512-byte sectors have been tested.

#### 3.2.2.2 Library Return Codes

```
#define USBH_BOMS_OK 0
```

Success for BOMS function.

```
#define USBH_BOMS_ERR_PARAMETER -1
```

Parameter error in call to BOMS function.

```
#define USBH_BOMS_ERR_CLASS_NOT_SUPPORTED -2
```

Device class not supported.

```
#define USBH_BOMS_ERR_SCSI -3
```

USB error received during SCSI commands.

```
#define USBH_BOMS_ERR_STATUS -5
```

Error received during status phase.

```
#define USBH_BOMS_ERR_CLASS -6
```

BOMS class error during function.

```
#define USBH_BOMS_ERR_LUN -7
```

Requested LUN is not available.

```
#define USBH_BOMS_ERR_CAPACITY_TIMEOUT -8
```

SCSI Get Capacity request timed out.

### 3.2.3 Structure Documentation

#### 3.2.3.1 USBH\_BOMS\_context

BOMS device context.

Holds a context structure required by each instance of the driver.

#### Data Fields

USBH_device_handle	hBomsDevice
USBH_interface_handle	hBomsInterface
uint8_t	bomsInterfaceNumber
USBH_endpoint_handle	hBomsEpIn
USBH_endpoint_handle	hBomsEpOut
uint8_t	maxLun
uint8_t	lun
uint32_t	lba_count

uint16_t	lba_size
uint16_t	vid
uint16_t	pid
uint8_t	vendorId [8]
uint8_t	productId [16]
uint8_t	rev [4]
uint32_t	tag

## Field Documentation

hBomsDevice

USB host device handle for BOMS device.

hBomsInterface

USB host interface handle for BOMS device.

bomsInterfaceNumber

Interface number for BOMS device.

hBomsEpIn

Handle for IN endpoint used by BOMS device.

hBomsEpOut

Handle for OUT endpoint used by BOMS device.

maxLun

Maximum LUN supported on this BOMS device.

lun

Current LUN in use.

lba\_count

Logical block count (number of sectors on device).

lba\_size

Size of logical blocks (sector size).

vid

VID of BOMS device.

pid

PID of BOMS device.

vendorId

String containing Vendor Name of BOMS device (may not be NULL terminated).

productId

String containing Product Name of BOMS device (may not be NULL terminated).

rev

Device specific revision information.

tag

Library Internal Use Tag.

### 3.2.4 Function Documentation

#### 3.2.4.1 *USBH\_BOMS\_init*

```
int8_t USBH_BOMS_init ( USBH_interface_handle hBomsInterface,  
                        uint8_t lun,  
                        USBH_BOMS_context * ctx  
                        )
```

Initialise the BOMS driver.

Set up a context for the BOMS driver to use the interfaces and settings provided in the call.

##### Parameters

- |                       |  |
|-----------------------|--|
| <b>hBomsInterface</b> | - Handle to the BOMS interface.  |
| <b>lun</b>            | - Logical Unit Number on device to use.  |
| <b>ctx</b>            | - Structure instantiated in the application to hold the context information for this instance of the driver. |

##### Returns

USBH\_BOMS\_OK if successful.

#### 3.2.4.2 *USBH\_BOMS\_get\_max\_lun*

```
int8_t USBH_BOMS_get_max_lun ( USBH_BOMS_context * ctx,  
                               uint8_t * maxLun  
                               )
```

Gets the number of LUNs on the BOMS device.

Queries the device to find the number of Logical Units on the device.

##### Parameters

- |               |   |
|---------------|---|
| <b>ctx</b>    | - Driver context.                                       |
| <b>maxLun</b> | - The number of the highest numbered LUN on the device. |

##### Returns

USBH\_BOMS\_OK if successful.

#### 3.2.4.3 *USBH\_BOMS\_reset*

```
int8_t USBH_BOMS_reset ( USBH_BOMS_context * ctx )
```

Reset the BOMS device.

Performs a BOMS device reset operation.

**Parameters**

**ctx** - Driver context.

**Returns**

USBH\_BOMS\_OK if successful.

**3.2.4.4 USBH\_BOMS\_read**

```
int8_t USBH_BOMS_read ( USBH_BOMS_context * ctx,
                        uint32_t          lba,
                        uint32_t          len,
                        uint8_t *         buffer
                        )
```

Read sectors from the BOMS device.

Read one or more sectors from the device. This function blocks until the required amount of data is read.

**Parameters**

**ctx** - Driver context.

**lba** - Logical Block Address (sector number) to commence read.

**len** - Number of bytes to read. This must be a multiple of the sector size.

**buffer** - Memory to receive data from on-disk sectors.

**Returns**

USBH\_BOMS\_OK if successful.

USBH\_BOMS\_ERR\_PARAMETER if length is not a multiple of the sector size.

USBH\_BOMS\_ERR\_SCSI if a SCSI (protocol error) occurred.

USBH\_BOMS\_ERR\_STATUS if the device returned a status error.

**3.2.4.5 USBH\_BOMS\_write**

```
int8_t USBH_BOMS_write ( USBH_BOMS_context * ctx,
                        uint32_t          lba,
                        uint32_t          len,
                        uint8_t *         buffer
                        )
```

Write sectors to the BOMS device.

Write one or more sectors to the device. This function blocks until the required amount of data is written.

**Parameters**

**ctx** - Driver context.

**lba** - Logical Block Address (sector number) to commence write.

- len** - Number of bytes to write. This must be a multiple of the sector size.
- buffer** - Memory to source data from.

**Returns**

USBH\_BOMS\_OK if successful.

USBH\_BOMS\_ERR\_PARAMETER if length is not a multiple of the sector size.

USBH\_BOMS\_ERR\_SCSI if a SCSI (protocol error) occurred.

USBH\_BOMS\_ERR\_STATUS if the device returned a status error.

**3.2.4.6 USBH\_BOMS\_mult\_read\_start**

```
int8_t USBH_BOMS_mult_read_start ( USBH_BOMS_context * ctx,
                                   uint32_t          lba,
                                   uint32_t          len
                                   )
```

Commence multiple sectors reads from the BOMS device.

Start a read of multiple sectors from the device. The function does not block allowing data to be processed as it is read. This allows large amounts of data to be streamed from the device without using large amounts of memory to hold the data for processing.

The **USBH\_BOMS\_mult\_read\_data()** function is used to perform the read – which must take exactly the number of bytes requested – before the **USBH\_BOMS\_mult\_end()** function completes the read. There must be no other BOMS operations while a multiple sector read operation is in process.

**Parameters**

- ctx** - Driver context.
- Lba** - Logical Block Address (sector number) to commence read.
- Len** - Number of bytes to read. This must be a multiple of the sector size.

**Returns**

USBH\_BOMS\_OK if successful.

USBH\_BOMS\_ERR\_PARAMETER if length is not a multiple of the sector size.

**3.2.4.7 USBH\_BOMS\_mult\_write\_start**

```
int8_t USBH_BOMS_mult_write_start ( USBH_BOMS_context * ctx,
                                     uint32_t          lba,
                                     uint32_t          len
                                     )
```

Commence multiple sectors writes to the BOMS device.

Start a write of multiple sectors to the device. The function does not block allowing data to be generated as it is written. This allows large amounts of data to be streamed to the device without using large amounts of memory to hold the data after generating it.

The **USBH\_BOMS\_mult\_write\_data()** function is used to perform the write – which must receive exactly the number of bytes requested – before the **USBH\_BOMS\_mult\_end()** function completes the write. There must be no other BOMS operations while a multiple sector write operation is in process.



**Parameters**

- ctx** - Driver context.
- Lba** - Logical Block Address (sector number) to commence write.
- Len** - Number of bytes to write. This must be a multiple of the sector size.

**Returns**

USBH\_BOMS\_OK if successful

USBH\_BOMS\_ERR\_PARAMETER length is not a multiple of the sector size.

**3.2.4.8 USBH\_BOMS\_mult\_read\_data**

```
int8_t USBH_BOMS_mult_read_data ( USBH_BOMS_context * ctx,
                                   uint32_t len,
                                   uint8_t * buffer
                                   )
```

Read sectors from the BOMS device during a multiple sector read.

Reads one or more sectors from a device after a multiple sector read has been started with the **USBH\_BOMS\_mult\_read\_start()** function.

**Parameters**

- ctx** - Driver context.
- Len** - Number of bytes to read. This must be a multiple of the sector size.
- Buffer** - Memory to receive data.

**Returns**

USBH\_BOMS\_OK if successful.

USBH\_BOMS\_ERR\_PARAMETER length is not a multiple of the sector size.

USBH\_BOMS\_ERR\_SCSI if a SCSI (protocol error) occurred.

USBH\_BOMS\_ERR\_STATUS the device returned a status error.

**3.2.4.9 USBH\_BOMS\_mult\_write\_data**

```
int8_t USBH_BOMS_mult_write_data ( USBH_BOMS_context * ctx,
                                    uint32_t len,
                                    uint8_t * buffer
                                    )
```

Write sectors to the BOMS device during a multiple sector write.

Writes one or more sectors to a device after a multiple sector write has been started with the **USBH\_BOMS\_mult\_write\_start()** function.

**Parameters**

- ctx** - Driver context.
- Len** - Number of bytes to write. This must be a multiple of the sector size.
- Buffer** - Memory to source data from.

**Returns**

USBH\_BOMS\_OK if successful  
USBH\_BOMS\_ERR\_PARAMETER length is not a multiple of the sector size.  
USBH\_BOMS\_ERR\_SCSI if a SCSI (protocol error) occurred.  
USBH\_BOMS\_ERR\_STATUS the device returned a status error.

**3.2.4.10 USBH\_BOMS\_mult\_end**

```
int8_t USBH_BOMS_mult_end ( USBH_BOMS_context * ctx )
```

Complete a multiple sector write or read.

Finishes a multiple sector write or read and checks the status.

**Parameters**

**ctx** - Driver context.

**Returns**

USBH\_BOMS\_OK if successful  
USBH\_BOMS\_ERR\_SCSI if a SCSI (protocol error) occurred.  
USBH\_BOMS\_ERR\_STATUS the device returned a status error.

**3.2.4.11 USBH\_BOMS\_status**

```
int8_t USBH_BOMS_status ( USBH_BOMS_context * ctx )
```

Get the device SCSI status.

Performs a SCSI Sense operation to retrieve the status of the BOMS device.

**Parameters**

**ctx** - Driver context.

**Returns**

USBH\_BOMS\_OK if successful.  
USBH\_BOMS\_ERR\_SCSI if a SCSI (protocol error) occurred.  
USBH\_BOMS\_ERR\_STATUS the device returned a status error.

## 3.3 CDC ACM Devices on USB Host Stack API

The file **ft900\_usbh\_cdcacm.h** contains the definitions for the USB host CDC ACM functions in the libft900.a library. API functions for USB Host stack. These functions provide additional functionality useful to implement a USB Host application. **Please refer to the documentation produced by the USB-IF covering CDC devices including the Class Definitions for Communications Devices 1.2.API Cross Reference.**

It utilises the following library APIs:

**ft900\_usbh.h** – USB host

**ft900\_usbhx.h** – USB host extensions

Additional definitions are taken from:

**ft900\_usb.h** – General USB definitions

**ft900\_usb\_cdc.h** –USB CDC definitions

### 3.3.1 Macro Definition Documentation

#### 3.3.1.1 Feature Configuration

```
#define CDCACM_FLAG_NO_NOTIFICATION 1
```

Do not expect or poll the notification endpoint in the Communication Class Interface.

```
#define CDCACM_IN_BUFFER 512
```

Size of internal receive circular buffer for CDC DATA interface.

```
#define CDCACM_IN_MAX_PACKET 512
```

Maximum packet size of data which may be received. On High-Speed devices this can be 512 bytes, on Full Speed this will be 64 bytes. The larger size will support both Full and High-Speed devices.

```
#define CDCACM_NOTIFICATION_BUFFER 12
```

Size of internal buffer used to hold notifications from the CDC CONTROL interface.

#### 3.3.1.2 Library Return Codes

```
#define USBH_CDCACM_OK 0
```

Success for CDC function.

```
#define USBH_CDCACM_ERR_PARAMETER -1
```

Parameter error in call to CDC function.

```
#define USBH_CDCACM_ERR_CLASS_NOT_SUPPORTED -2
```

Device class not supported.

```
#define USBH_CDCACM_ERR_CLASS -3
```

Class request not supported.

```
#define USBH_CDCACM_ERR_DATA_ENDPOINT -5
```

Data Endpoints not found or polling failed.

```
#define USBH_CDCACM_ERR_FUNCTIONAL_DESCRIPTOR -6
```

Function descriptor not found.

```
#define USBH_CDCACM_ERR_USB -7
```

Unexpected USB error occurred.

### 3.3.2 Structure Documentation

#### 3.3.2.1 USBH\_CDCACM\_context

CDC ACM device context.

Holds a context structure required by each instance of the driver.

##### Data Fields

USBH_device_handle	hControlDevice
USBH_interface_handle	hControlInterface

USBH_interface_handle	hDataInterface
USBH_endpoint_handle	hControlEpIn
USBH_endpoint_handle	hDataEpIn
USBH_endpoint_handle	hDataEpOut
uint8_t	controlInterfaceNumber
uint8_t	dataInterfaceNumber
uint8_t	callCapabilities
uint8_t	acmCapabilities
USB_CDC_UartStateBitmap	uartState
USB_CDC_UartStateBitmap	networkState
int8_t	responseAvailable
int8_t	notificationStatus
uint32_t	notificationBuffer [ CDCACM_NOTIFICATION_BUFFER/ sizeof(uint32_t)]
int8_t	recvStatus
uint32_t	recvPacket [ CDCACM_IN_MAX_PACKET/ sizeof(uint32_t)]
uint8_t	recvBuffer [CDCACM_IN_BUFFER]
volatile uint16_t	recvBufferWrite
volatile uint16_t	recvBufferRead
volatile uint16_t	recvBufferAvail

## Field Documentation

hControlDevice

USB host device handle to the CDC device. There may be multiple CDC interfaces on the same devices.

hControlInterface

USB host interface handle for CDC CONTROL interface.

hDataInterface

USB host interface handle for CDC DATA interface.

hControlEpIn

USB host endpoint handle for CDC CONTROL endpoint.

hDataEpIn

USB host endpoint handle for CDC DATA interface IN endpoint.

hDataEpOut

USB host endpoint handle for CDC DATA interface OUT endpoint.

controlInterfaceNumber

Interface number for CDC CONTROL interface. These are used in SETUP requests to identify the correct interface.

dataInterfaceNumber

Interface number for CDC DATA interface. These are used in SETUP requests to identify the correct interface.

callCapabilities

Call Management capabilities. Bitmap from Call Management Functional descriptor indicating the method for managing calls on the device.

acmCapabilities

Abstract Control Management capabilities. Bitmap from Abstract Control Management Functional descriptor indicating support for Comm, Line Coding, Break and Network features.

uartState

Notification bitmap for the UART state received from device.

networkState

Notification bitmap for the network state received from device.

responseAvailable

Response available notification flag indicating that an encapsulated response can be read from the interface.

notificationStatus

Last status of CDC CONTROL notification poll from USB Host driver.

notificationBuffer

Buffer to receive notification structure from USB Host driver. This must be of type uint32\_t to follow alignment requirements of data buffers in USB Host driver.

recvStatus

Last status of CDC DATA IN endpoint poll from USB Host driver.

recvPacket

Buffer to receive data from the USB Host driver. This is exactly one MaxPacket size buffer. It must be of type uint32\_t to follow alignment requirements of data buffers in USB Host driver.

Note: can be of type uint8\_t if it is qualified with: \_\_attribute\_\_((aligned (4))).

recvBuffer

Circular buffer used to group packet data from the USB Host. This does not have any alignment issues.

recvBufferWrite

Write pointer for circular buffer (internal use).

recvBufferRead

Read pointer for circular buffer (internal use).

recvBufferAvail

Available space counters for circular buffer (internal use).

### 3.3.3 Function Documentation

#### 3.3.3.1 *USBH\_CDCACM\_init*

```
int8_t USBH_CDCACM_init ( USBH_interface_handle    hControlInterface,  
                          uint8_t                  flags,  
                          USBH_CDCACM_context *    ctx  
                          )
```

Initialise the CDC ACM driver.

Setup a context for the CDC driver to use the interfaces and settings provided in the call.

##### Parameters

**hControlInterface** - handle to the CDC CONTROL interface.

**flags** - Set the flag to CDCACM\_FLAG\_NO\_NOTIFICATIONS to disable polling the notification endpoint.

**ctx** - Structure instantiated in the application to hold the context information for this instance of the driver.

##### Returns

USBH\_CDCACM\_OK if successful.

#### 3.3.3.2 *USBH\_CDCACM\_read*

```
int32_t USBH_CDCACM_read ( USBH_CDCACM_context *    ctx,  
                           uint8_t *                  buffer,  
                           size_t                      len  
                           )
```

Read data from the CDC ACM device.

Read a block of data from the CDC device DATA interface. The data is buffered internally in the driver as it is produced by the CDC device and polled by the USB host. The buffer is designed to discard incoming data if the internal buffer fills. Care must therefore be taken to ensure an adequate consumption rate of data from the CDC device.

##### Parameters

**ctx** - Context information for this instance of the driver.

**Buffer** - receiving buffer.

**Len** - Maximum length of data to read.

##### Returns

Number of bytes transferred to the receiving buffer. This may be less than the amount requested if insufficient data has been received from the CDC device.  
A negative value will represent an error on the USB host.

### 3.3.3.3 *USBH\_CDCACM\_write*

```
int32_t USBH_CDCACM_write ( USBH_CDCACM_context * ctx,
                           uint8_t *          buffer,
                           size_t             len
                           )
```

Write data to the CDC ACM device.

Write a block of data to the CDC device DATA interface. Data is written immediately to the device without buffering.

#### Parameters

- ctx** - Context information for this instance of the driver.
- Buffer** - Transmission buffer.
- Len** - Maximum length of data to write.

#### Returns

Number of bytes transferred from the transmission buffer to the device.  
A negative value will represent an error on the USB host.

### 3.3.3.4 *USBH\_CDCACM\_get\_poll\_status*

```
void USBH_CDCACM_get_poll_status ( USBH_CDCACM_context * ctx,
                                   int8_t *              notification_status,
                                   int8_t *              data_status
                                   )
```

Returns the last USB Host statuses for endpoint polling.

Each time an endpoint is polled the status is stored. Both the notification endpoint and the data IN endpoint values are stored and can be queried by this function.

#### Parameters

- ctx** - Context information for this instance of the driver.
- Notification\_status** - Pointer to receive status of notification endpoint polling.
- Data\_status** - Pointer to receive status of data endpoint polling.

#### Returns

N/A.

### 3.3.3.5 *USBH\_CDCACM\_set\_comm\_feature*

```
int8_t USBH_CDCACM_set_comm_feature ( USBH_CDCACM_context * ctx,
                                       uint16_t             selector,
                                       uint16_t             feature
                                       )
```

Set Comm Features on the device.

The selector parameter is used to select between the abstract state and country setting data.

**Parameters**

- ctx** - Context information for this instance of the driver.
- Selector** - Abstract State or Country Setting:  
CDC\_ACM\_FEATURE\_SELECTOR\_ABSTRACT\_STATE,  
CDC\_ACM\_FEATURE\_SELECTOR\_COUNTRY\_SETTING.
- Feature** - Bitmap to set the abstract state bitmap or country setting code.

**Returns**

USBH\_CDCACM\_OK if the interface supports the COMM Feature requests.  
USBH\_CDCACM\_ERR\_CLASS if the interface does not support it.

**3.3.3.6 USBH\_CDCACM\_clear\_comm\_feature**

```
int8_t USBH_CDCACM_clear_comm_feature ( USBH_CDCACM_context * ctx,  
                                         uint16_t selector  
                                         )
```

Clear the Comm Features on the device.

The selector parameter is used to select between the abstract state and country setting data.

**Parameters**

- ctx** - Context information for this instance of the driver.
- Selector** - Abstract State or Country Setting:  
CDC\_ACM\_FEATURE\_SELECTOR\_ABSTRACT\_STATE,  
CDC\_ACM\_FEATURE\_SELECTOR\_COUNTRY\_SETTING.

**Returns**

USBH\_CDCACM\_OK if the interface supports the COMM Feature requests.  
USBH\_CDCACM\_ERR\_CLASS if the interface does not support it.

**3.3.3.7 USBH\_CDCACM\_get\_acm\_capabilities**

```
int8_t USBH_CDCACM_get_acm_capabilities ( USBH_CDCACM_context * ctx )
```

Returns the ACM Capabilities bitmap.

Returns the bmCapabilities value obtained from the Abstract Control Management Functional Descriptor for the CDC ACM interface.

**Parameters**

- ctx** - Context information for this instance of the driver.

**Returns**

Values are defined as CDC\_ACM\_CAPABILITIES\_\*

**3.3.3.8 USBH\_CDCACM\_get\_call\_capabilities**

```
int8_t USBH_CDCACM_get_call_capabilities ( USBH_CDCACM_context * ctx )
```

Returns the Call Capabilities bitmap.

Returns the bmCapabilities value obtained from the Call Management Functional Descriptor for the CDC ACM interface.



**Parameters**

**ctx** - Context information for this instance of the driver.

**Returns**

Values are defined as CDC\_CM\_CAPABILITIES\_\*

**3.3.3.9 USBH\_CDCACM\_get\_comm\_feature**

```
int8_t USBH_CDCACM_get_comm_feature ( USBH_CDCACM_context * ctx,
                                      uint16_t selector,
                                      uint16_t * feature
                                      )
```

Get a bitmap containing the currently set Comm Features.

The selector parameter is used to select between the abstract state and country setting data.

**Parameters**

**ctx** - Context information for this instance of the driver.

**Selector** - Abstract State or Country Setting:  
CDC\_ACM\_FEATURE\_SELECTOR\_ABSTRACT\_STATE,  
CDC\_ACM\_FEATURE\_SELECTOR\_COUNTRY\_SETTING.

**Feature** - Bitmap to receive abstract state bitmap or country setting code.

**Returns**

USBH\_CDCACM\_OK if the interface supports the COMM Feature requests.  
USBH\_CDCACM\_ERR\_CLASS if the interface does not support it.

**3.3.3.10 USBH\_CDCACM\_get\_encapsulated\_response**

```
int8_t USBH_CDCACM_get_encapsulated_response ( USBH_CDCACM_context * ctx,
                                                char * rsp,
                                                uint16_t len
                                                )
```

Read an encapsulated command response from the CDC ACM device.

Read a block of data from the CDC device control interface. Data is read immediately to the device without buffering.

**Parameters**

**ctx** - Context information for this instance of the driver.

**Rsp** - receive buffer for receiving response.

**Len** - Maximum length of data to receive.

**Returns**

Number of bytes transferred from the device to the receive buffer.

### **3.3.3.11 USBH\_CDCACM\_get\_line\_coding**

```
int8_t USBH_CDCACM_get_line_coding ( USBH_CDCACM_context * ctx,  
                                     USB_CDC_line_coding * coding  
                                     )
```

Get Current Line Coding settings from the device.

The **USB\_CDC\_line\_coding** structure describes the data output format on the "UART" side of the CDC device. This will query the settings and return them in the structure.

#### **Parameters**

- ctx** - Context information for this instance of the driver.
- Coding** - Pointer to structure containing the currently set parameters for formatting data.

#### **Returns**

USBH\_CDCACM\_OK if the interface supports the Line Coding Feature requests.  
USBH\_CDCACM\_ERR\_CLASS if the interface does not support it.

### **3.3.3.12 USBH\_CDCACM\_set\_line\_coding**

```
int8_t USBH_CDCACM_set_line_coding ( USBH_CDCACM_context * ctx,  
                                     USB_CDC_line_coding * coding  
                                     )
```

Set Line Coding on the device.

The **USB\_CDC\_line\_coding** structure is used to set the data output format on the CDC device. This is on the "UART" side of the device.

#### **Parameters**

- ctx** - Context information for this instance of the driver.
- Coding** - Pointer to structure containing the requested parameters for formatting data.

#### **Returns**

USBH\_CDCACM\_OK if the interface supports the Line Coding Feature requests.  
USBH\_CDCACM\_ERR\_CLASS if the interface does not support it.

### **3.3.3.13 USBH\_CDCACM\_get\_network\_connection**

```
uint8_t USBH_CDCACM_get_network_connection ( USBH_CDCACM_context * ctx,  
                                              USB_CDC_NetworkConnectionBitmap * state  
                                              )
```

Returns the Network state bitmap.

When a notification arrives updating the Network state, this is kept in the driver and can be queried by this command.

#### **Parameters**

- ctx** - Context information for this instance of the driver.

**State** - Pointer to structure to receive last received state.

#### Returns

USBH\_CDCACM\_OK if the interface supports the Network\_Connection notification.  
USBH\_CDCACM\_ERR\_CLASS if the interface does not support it.

#### 3.3.3.14 USBH\_CDCACM\_get\_uart\_state

```
uint8_t USBH_CDCACM_get_uart_state ( USBH_CDCACM_context *   ctx,  
                                     USB_CDC_UartStateBitmap * state  
                                     )
```

Returns the UART state bitmap.

When a notification arrives updating the UART state, this is kept in the driver and can be queried by this command.

#### Parameters

**ctx** - Context information for this instance of the driver.

**State** - Pointer to structure to receive last received state.

#### Returns

USBH\_CDCACM\_OK if the interface supports the Serial\_State notification.  
USBH\_CDCACM\_ERR\_CLASS if the interface does not support it.

#### 3.3.3.15 USBH\_CDCACM\_set\_control\_line\_state

```
int8_t USBH_CDCACM_set_control_line_state ( USBH_CDCACM_context *   ctx,  
                                             USB_CDC_control_line_state * state  
                                             )
```

Set Control Line State on the device.

The **USB\_CDC\_control\_line\_state** structure is used to set the state of the control lines on the CDC device. This is on the "UART" side of the device.

#### Parameters

**ctx** - Context information for this instance of the driver.

**State** - Pointer to structure containing the requested state for the control lines.

#### Returns

USBH\_CDCACM\_OK if the interface supports the Line Coding Feature requests.  
USBH\_CDCACM\_ERR\_CLASS if the interface does not support it.

#### 3.3.3.16 USBH\_CDCACM\_get\_response\_available

```
int8_t USBH_CDCACM_get_response_available ( USBH_CDCACM_context * ctx )
```

Indicates the response to an encapsulated command is waiting.

When a notification arrives indicating that a response to an encapsulated command is waiting to be read, this is kept in the driver and can be queried by this command.

**Parameters**

**ctx** - Context information for this instance of the driver.

**Returns**

Non-zero if an encapsulated response is available.

**3.3.3.17 USBH\_CDCACM\_send\_encapsulated\_command**

```
int8_t USBH_CDCACM_send_encapsulated_command ( USBH_CDCACM_context * ctx,
                                                char * cmd,
                                                uint16_t len
                                                )
```

Send an encapsulated command to the CDC ACM device.

Write a block of data to the CDC device control interface. Data is written immediately to the device without buffering.

**Parameters**

**ctx** - Context information for this instance of the driver.

**Cmd** - Transmission buffer containing command.

**Len** - Maximum length of data to write.

**Returns**

Number of bytes transferred from the transmission buffer to the device.

**3.3.3.18 USBH\_CDCACM\_send\_break**

```
int8_t USBH_CDCACM_send_break ( USBH_CDCACM_context * ctx,
                                uint16_t duration
                                )
```

Instructs the device to set a break state on the UART line.

**Parameters**

**ctx** - Context information for this instance of the driver.

**Duration** - Length of time in milliseconds to set the break state.

**Returns**

USBH\_CDCACM\_OK if the interface supports the Send\_Break request.  
USBH\_CDCACM\_ERR\_CLASS if the interface does not support it.

## 4 Header Files

### 4.1 Hardware Register Definition Files

The following is a list of all hardware register definition files. These are located in the inc/registers directory.

<b>ft900_adc_dac_registers.h</b>	ADC/DAC registers
<b>ft900_cam_registers.h</b>	Camera/Parallel interface registers
<b>ft900_can_registers.h</b>	CANBus registers
<b>ft900_ehci_registers.h</b>	EHCI registers
<b>ft900_eth_registers.h</b>	Ethernet registers
<b>ft900_flash_registers.h</b>	Flash controller registers
<b>ft900_gpio_registers.h</b>	General Purpose IO and Pad control registers
<b>ft900_i2c_registers.h</b>	I2C registers
<b>ft900_i2s_registers.h</b>	I2S registers
<b>ft900_interrupt_registers.h</b>	Interrupt management registers
<b>ft900_pwm_registers.h</b>	Pulse Width Modulation registers
<b>ft900_registers.h</b>	FT90x and FT93x register definitions
<b>ft900_rtc_registers.h</b>	Real Time Clock registers
<b>ft900_sdhost_registers.h</b>	SD Host registers
<b>ft900_spi_registers.h</b>	SPI registers
<b>ft900_sys_registers.h</b>	Chip management registers
<b>ft900_timer_wdt_registers.h</b>	Timer and Watchdog registers
<b>ft900_uart_registers.h</b>	UART registers
<b>ft900_usbd_registers.h</b>	USB registers
<b>ft900_usbd_hbw_register.h</b>	High Bandwidth ISO configuration registers
<b>ft930_slave_cpu_registers.h</b>	Registers to control the D2XX hardware engine

#### 4.1.1 Using Register Header Files

The register header files can be used to directly access the device registers.

Here are the steps involved:

1. Find the module define in ft900\_registers.h
2. Find the register to access in the associated register header file.
3. Decide if any of the constants will be used to help set or clear specific bit fields.

#### 4.1.1.1 Example 1 –Read a Register

To read the Chip ID Register in the General System Registers:

```
uint32_t HIPID_value;
```

```
HIPID_value = SYS->HIPID;
```

#### 4.1.1.2 Example 2 –Write to a Register

To set the entire CAN 0 Interrupt enables:

```
CAN0->CAN_INT_ENABLE |= 0x7F;
```

#### 4.1.1.3 Example 3 –Set and Clear Bits

To bring the CAN 0 module out of reset (set RST to 0):

```
CAN0->CAN_MODE &= ~MASK_CAN_MODE_RST;
```

To put the CAN 0 back into reset (set RST to 1):

```
CAN0->CAN_MODE |= MASK_CAN_MODE_RST;
```

## 4.2 API Header Files

This is a list of all the API header files. These are located in the inc directory.

<b>ft900.h</b>	FT9xx API (all include files)
<b>ft900_adc.h</b>	Analogue to Digital Converter
<b>ft900_asm.h</b>	FT9xx Assembler Macros
<b>ft900_cam.h</b>	Camera interface
<b>ft900_can.h</b>	CANBus
<b>ft900_dac.h</b>	Digital to Analogue Converter
<b>ft900_delay.h</b>	Delay functions
<b>ft900_eth.h</b>	Ethernet driver
<b>ft900_gpio.h</b>	General Purpose I/O and Pad control
<b>ft900_i2cm.h</b>	I2C Master
<b>ft900_i2cs.h</b>	I2C Slave
<b>ft900_i2s.h</b>	I2S Audio
<b>ft900_interrupt.h</b>	Interrupt management
<b>ft900_pwm.h</b>	Pulse Width Modulation
<b>ft900_pwm_pcm.h</b>	PWM Audio
<b>ft900_rtc.h</b>	Real Time Clock
<b>ft900_sdhost.h</b>	SD Host
<b>ft900_spi.h</b>	SPI
<b>ft900_startup_dfu.h</b>	Startup DFU Feature
<b>ft900_sys.h</b>	Chip management

<b>ft900_timers.h</b>	Timers
<b>ft900_uart_simple.h</b>	UART
<b>ft900_usbd.h</b>	USB Device API
<b>ft900_usbd_dfu.h</b>	DFU device for USB device stack API
<b>ft900_usbd_hbw.h</b>	USB Device High Bandwidth Isochronous IN support API on FT90x Rev C.
<b>ft900_usbd_rndis.h</b>	RNDIS Device for USB device stack API
<b>ft900_usbh.h</b>	USB host stack API
<b>ft900_usbh_boms.h</b>	BOMS devices on USB host stack API
<b>ft900_usbh_cdcacm.h</b>	CDC ACM devices on USB host stack API
<b>ft900_usbh_hid.h</b>	HID devices on USB host stack API
<b>ft900_usbh_aoa.h</b>	AOA devices on USB host stack API
<b>ft900_usbhx.h</b>	USB host API extensions
<b>ft900_wdt.h</b>	Watchdog Timer
<b>ftd2xx_api.h</b>	D2XX Solution API for FT9xx

## 4.3 Additional Header Files

This list contains all additional header files that are not directly part of the API but provide additional definitions for the API and applications. They are located in the inc directory.

<b>ft900_usb.h</b>	USB definitions
<b>ft900_usb_boms.h</b>	USB BOMS class definitions
<b>ft900_usb_cdc.h</b>	USB CDC class USB definitions
<b>ft900_usb_dfu.h</b>	USB DFU class definitions
<b>ft900_usb_hid.h</b>	USB HID class definitions
<b>ft900_usb_aoa.h</b>	USB AOA class definitions
<b>ft900_usb_rndis.h</b>	USB RNDIS class definitions
<b>ft900_usb_uvc.h</b>	USB UVC class definitions

## 5 Contact Information

Refer to <https://brtchip.com/contact-us/> for contact information.

### Distributor and Sales Representatives

Please visit the [Sales Network](#) page for the contact details of our distributor(s) and sales representative(s) in your country.

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## Appendix A – References

### Document References

[FT900/FT901/FT902/FT903 Datasheet](#)

[FT905/FT906/FT907/FT908 Datasheet](#)

[FT930/FT931/FT932/FT933 Datasheet](#)

[AN\\_325 FT9XX Toolchain Installation Guide](#)

[BRT\\_AN\\_089 FT9XX USB Device Extended API](#)

GNU Make Manual-- 9.5 Overriding Variables  
 ([http://www.gnu.org/software/make/manual/html\\_node/Overriding.html#Overriding](http://www.gnu.org/software/make/manual/html_node/Overriding.html#Overriding))

USB-IF Device Firmware Upgrade 1.1 Specification  
[https://www.usb.org/sites/default/files/DFU\\_1.1.pdf](https://www.usb.org/sites/default/files/DFU_1.1.pdf)

USB-IF Class definitions for Communication Devices 1.2  
[https://www.usb.org/sites/default/files/CDC1.2\\_WMC1.1\\_012011.zip](https://www.usb.org/sites/default/files/CDC1.2_WMC1.1_012011.zip)

USB-IF Device Class definition for HID 1.11  
[https://www.usb.org/sites/default/files/hid1\\_11.pdf](https://www.usb.org/sites/default/files/hid1_11.pdf)

USB-IF Mass Storage Bulk Only  
[http://www.usb.org/developers/docs/devclass\\_docs/usbmassbulk\\_10.pdf](http://www.usb.org/developers/docs/devclass_docs/usbmassbulk_10.pdf)

Android Open Accessory Specification  
<https://source.android.com/devices/accessories/aoa2.html>

[AN\\_324 FT900 User Manual](#)

### Acronyms and Abbreviations

Terms	Description
ADC	Analogue to Digital Converter
AOA	Android Open Accessory
ARP	Address Resolution Protocol
BOMS	Bulk Only Mass Storage
CAN	Controller Area Network
CDC	Communication Device Class
DAC	Digital to Analogue Converter
DFU	Device Firmware Upgrade
EEPROM	Electrically Erasable Programmable Memory

GPIO	General Purpose I/O
HID	Human Interface Device
I <sup>2</sup> C	Inter-IC
I <sup>2</sup> S	Inter-IC Sound
ICMP	Internet Control Messaging Protocol
MDI-X	Medium Dependent Interface Crossover
PC	Personal Computer
PWM	Pulse Width Modulation
RNDIS	Remote Network Driver Interface Specification
RTC	Real Time Clock
SD	Secure Digital
SPI	Serial Peripheral Interface
UART	Universal Asynchronous Receiver Transmitter
WDT	Watchdog Timer

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## Appendix C – Revision History

Document Title: AN\_365 FT9XX API Programmers Manual  
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 Product Page: <https://brtchip.com/ft9xx-toolchain/>  
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Revision	Changes	Date
1.0	Initial Release	29-06-2015
1.1	Updated to reflect changes in USB Host API	14-09-2015
1.2	Added USBH AOA API, Datalogger and D2XX API	25-02-2016
1.3	Updated USBH, STARTUP_DFU sections and Added 'FT devices on USB host stack' API	20-09-2016
1.4	Updated release Migration of the product from FTDI to Bridgetek name – logo changed, copyright changed, contact information changed	09-03-2017
1.5	Updated D2XX_Init() call with the integration notes about the usage of Timer D inside the library.	05-07-2017
1.6	Updated document for - FT900C porting. Following topics are updated – SD Host, CAN, RTC, SPI, I2S, I2C, UART, USBH_HW; RTC on the compatibility for FT900 rev B.	19-01-2018
1.7	Updated for v2.6.0 release	18-05-2022
1.8	Updated for v2.7.0 release	29-08-2023