Application Note

AN_395

User Guide for LibFT260

Version 1.4

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The FT260 is a USB device which supports I²C and UART communication through the standard USB HID interface. This application note is a guide for LibFT260, which provides high-level and convenient APIs for FT260 application development.

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Table of Contents

1 Introduction

1.1 Overview

The FT260 is a full speed USB device which supports I²C and UART communication through standard USB HID interfaces. The USB HID class is natively supported by most operating systems. A custom driver is not required to be installed for the FT260. By default, the FT260 has two HID interfaces:

- The first HID interface sends and receives data via the **I²C** connection.
- The second HID interface sends and receives data via the **UART** connection.
- The HID interface can be configured by the DCNF0 and DCNF1 pins.

The USB HID class exchanges data between a host and a device by reports. There are three types of reports in USB HID:

1. **Feature report:** Configuration data are exchanged between the host and the HID device through a control pipe. The feature report is usually used to turn on/off a device function.
2. **Input report:** Data content that is sent from the HID device to the host.
3. **Output report:** Data content that is sent from the host to the HID device.

The FT260 device receives output reports from the HID application, decodes the requests, and passes the data to the connected I²C or UART device. Data received from the I²C or UART device is sent to the host by input reports.

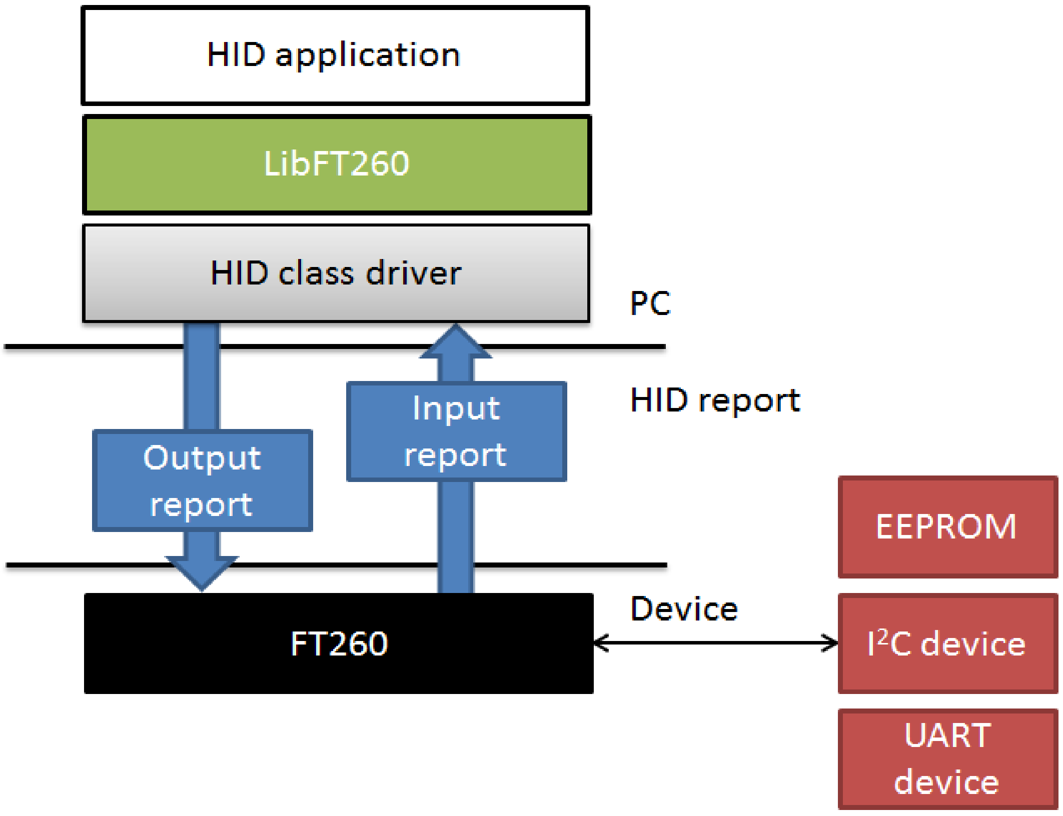


Figure 1.1 The FT260 System Block Diagram

1.2 FT260 HID Interfaces and Endpoints

1.2.1 Interfaces

The FT260 interfaces can be configured as:

- **I²C** and **UART**
- **I²C** only
- **UART** only

The interfaces can be configured by mode pins: DCNF0 and DCNF1.

DCNF1	DCNF0	HID Interfaces
0	0	The default mode. The FT260 will create two HID interfaces: **I²C** and **UART**. This mode is the same as mode (1,1).
0	1	The FT260 will create a HID interface which sends and receives data via the **I²C** connection.
1	0	The FT260 will create a HID interface which sends and receives data via the **UART** connection.
1	1	The FT260 will create two HID interfaces: • The first HID interface sends and receives data via the **I²C** connection. • The second HID interface sends and receives data via the **UART** connection.

Table 1.1 FT260 interface configuration

1.2.2 Endpoints

An interface of the FT260 is composed of the following endpoints:

Endpoint	Usage
Control In	Input reports, Feature reports sent to the host with a GET_REPORT request
Control Out	Output reports, Feature reports received from the host with a SET_REPORT request
Interrupt In	Input reports
Interrupt Out	Output reports

Table 1.2 FT260 endpoints

1.3 Scope

The guide is intended for developers who are creating applications, extending FTDI provided applications or implementing FTDI's applications for the FT260.

The support library, LibFT260, hides the detail of communicating by HID protocol and provides simple APIs for developers to create their own applications.

The sample source code provided in this application note is an example and is neither guaranteed nor supported by FTDI.

2 Wiring

2.1 I²C

The FT260 I²C is open-drain architecture. It requires a suitable pull-high resistor on the I²C bus.

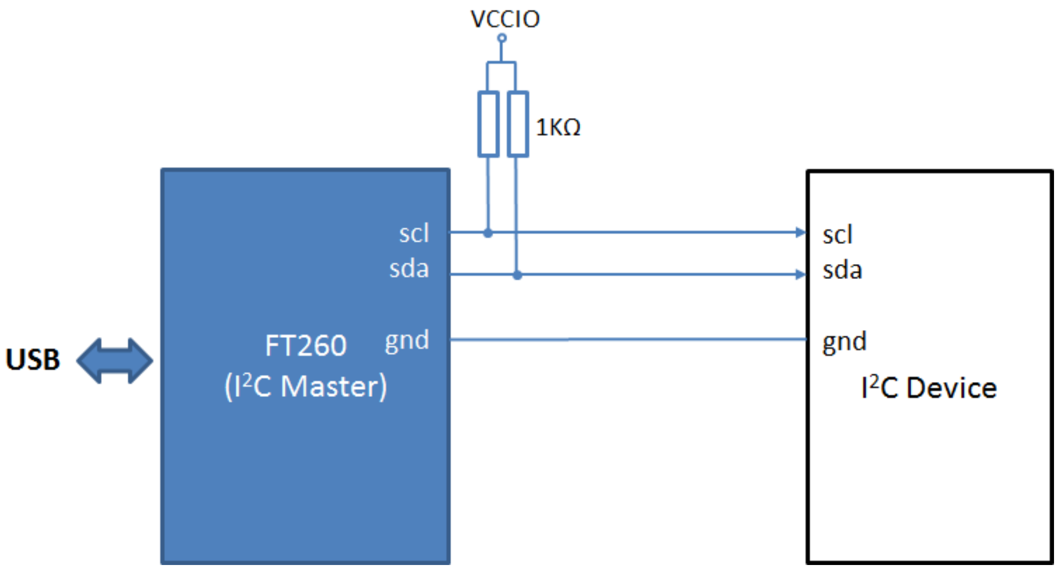


Figure 2.1 The FT260 connects with I²C bus

2.2 UART

The FT260 UART supports 3 flow control modes:

- Software flow control (default)
- Hardware flow control by CTS and RTS
- Hardware flow control by DTR and DSR

Software flow control mode is the default flow control mode of the FT260 and it has the simplest wiring. It only requires connecting TXD, RXD and GND. CTS, RTS, and DTR, DSR are optional for hardware flow control.

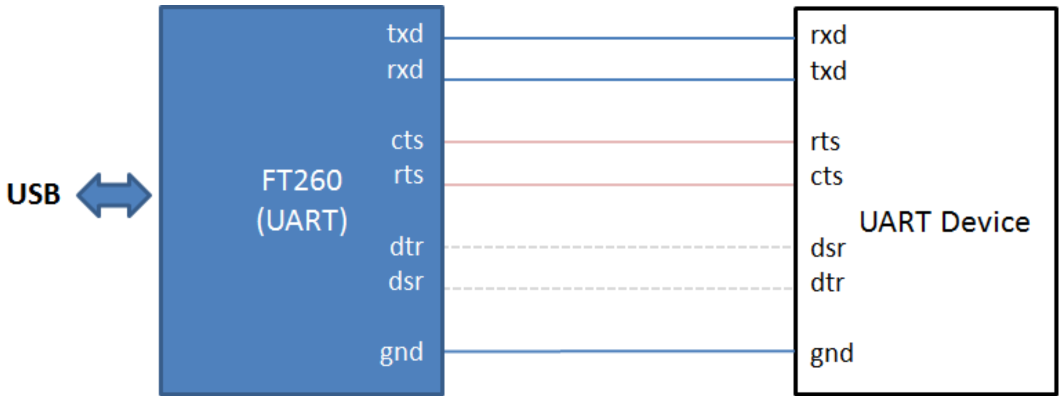


Figure 2.2 The FT260 connects to an UART device

3 Getting Started

This example shows how to open the device with the LibFT260 support library. After opening the device, developers need to initialize the FT260 device as either an I^{2}C master or a UART. Different device types require different configurations. For more details refer to chapter 4.

Example

```
#include <windows.h>
#include <stdio.h>
#include <stdlib.h>
#include "LibFT260.h"
#define MASK_1 0x0f

void ListAllDevicePaths()
{
    DWORD devNum = 0;
    WCHAR pathBuf[128];

    FT260_CreateDeviceList(&devNum);

    for(int i = 0; i < devNum; i++)
    {
        FT260_GetDevicePath(pathBuf, 128, i);
        wprintf(L"Index:%d\nPath:%s\n\n", i, pathBuf);
    }
}

int main(int argc, char const* argv[])
{
    FT260_STATUS ftStatus = FT260_OTHER_ERROR;
    FT260_HANDLE ft260Handle = INVALID_HANDLE_VALUE;
    DWORD devNum = 0;


    ListAllDevicePaths();


    // Open device by index
    ftStatus = FT260_Open(0, & ft260Handle);
    if (FT260_OK != ftStatus) {
        printf("Open device Failed, status: %d\n", ftStatus);
        return 0;
    }
    else {
        printf("Open device OK\n");
    }

    // Show version information

    DWORD dwChipVersion = 0;

    ftStatus = FT260_GetChipVersion(ft260Handle, &dwChipVersion);
    if (FT260_OK != ftStatus)
    {
        printf("Get chip version Failed, status: %d\n", ftStatus);
    }
    else
    {
        printf("Get chip version OK\n");
        printf("Chip version : %d.%d.%d.%d\n",
            ((dwChipVersion >> 24) & MASK_1),
            ((dwChipVersion >> 16) & MASK_1),
            ((dwChipVersion >> 8) & MASK_1),
            (dwChipVersion & MASK_1) );
    }
    //    Initialize as an I2C master, and read/write data to an I2C slave
    //    FT260_I2CMaster_Init
    //    FT260_I2CMaster_Read
    //    FT260_I2CMaster_Write

    // Close device
    FT260_Close(ft260Handle);
    return 0;
}
```

4 Application Programming Interface (API)

LibFT260 supports I^{2}C, UART and GPIO communication by using high-level APIs. In addition, it provides chip configuration APIs, such as FT260_SetClock. After opening the FT260 device, the FT260 could be initialized by one of the following initial functions:

- FT260_I2CMaster_Init
- FT260_UART_Init

The initialization functions set up the FT260 for the subsequent operations.

Refer to Appendix C – FT260_STATUS for the definitions of the error code of following functions.

4.1 FT260 General Functions

The functions listed in this section are configuration functions for the FT260.

4.1.1 FT260_CreateDeviceList

FT260_STATUS **FT260_CreateDeviceList** (LPDWORD lpdwNumDevs)

Summary:

Create device list and get the number of HID devices.

Note: The call creates a list for all HID devices, not only FT260 devices.

Parameters:

lpdwNumDevs	Pointer to a variable for retrieving the number of HID devices.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.2 FT260_GetDevicePath

FT260_STATUS **FT260_GetDevicePath**(WCHAR* pDevicePath, DWORD bufferLength, DWORD deviceIndex)

Summary:

Get device path by index.

The device path data would be of a format such as shown below:
\\?\hid#vid_0403&pid_6030&mi_00#8&1d5b3f5a&0&0000#{4d1e55b2-f16f-11cf-88cb-001111000030}

Parameters:

pDevicePath	Pointer to the buffer for getting data.
bufferLength	The maximum number of characters to store. Note that the device path is WCHAR.
deviceIndex	The index of the device, which is 0 based.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.3 FT260_Open

FT260_STATUS **FT260_Open**(int iDevice, FT260_HANDLE* pFt260Handle)

Summary:

Open device by index.

Parameters:

iDevice	The index of the device, which is 0 based.
pFt260Handle	Pointer to a variable of type FT260_HANDLE where the handle will be stored. This handle must be used to access the device.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.4 FT260_OpenByVidPid

FT260_STATUS **FT260_OpenByVidPid**(WORD vid, WORD pid, DWORD deviceIndex, FT260_HANDLE* pFt260Handle)

Summary:

Open device by the given VID, PID and index.

For example, call this function with VID, PID and index. If there are many same VID, PID devices plugged in the host and they are sorted by device path.

Parameters:

vid	USB vendor ID.
pid	USB product ID
deviceIndex	The index of the device, which is 0 based. There might be several devices with the same VID/PID. Use the index to select the device.
pHandle	Pointer to a variable of type FT260_HANDLEwhere the handle will be stored. This handle must be used to access the device.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.5 FT260_OpenBySerialNumber

FT260_STATUS **FT260_OpenBySerialNumber**(char * pSerialNumber, DWORD deviceIndex, FT260_HANDLE* pFt260Handle)

Summary:

Open device by the given serial number and index.

For example, call this function with serial number and index. When using more than one FT260 device on the same host where the application will open by serial number, it is recommended to set each device with a different serial number using FT_PROG. In this case, the index should be set to 0 when calling this function as there will only be one device with each serial number.

If there are many devices with the same serial number plugged into the host, they are sorted by device path. In this case, the index can be used to differentiate between them.

Parameters:

pSerialNumber	USB serial number
deviceIndex	The index of the device, which is 0 based. There might be several devices with the same serial number. Use the index to select the device.
pHandle	Pointer to a variable of type FT260_HANDLEwhere the handle will be stored. This handle must be used to access the device.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.6 FT260_OpenByProductDescription

FT260_STATUS **FT260_OpenByProductDescription**(char * pDescription, DWORD deviceIndex, FT260_HANDLE* pFt260Handle)

Summary:

Open device by the given product description and index.

For example, call this function with product description and index. When using more than one FT260 device on the same host where the application will open by description, it is recommended to set each device with a different description using FT_PROG. In this case, the index should be set to 0 when calling this function as there will only be one device with each description.

If there are many devices with the same description plugged into the host, they are sorted by device path. In this case, the index can be used to differentiate between them.

Parameters:

pDescription	USB product description
deviceIndex	The index of the device, which is 0 based. There might be several devices with the same product description. Use the index to select the device.
pHandle	Pointer to a variable of type FT260_HANDLEwhere the handle will be stored. This handle must be used to access the device.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.7 FT260_OpenByDevicePath

FT260_STATUS **FT260_OpenByDevicePath**(WCHAR* pDevicePath, FT260_HANDLE* pFt260Handle)

Summary:

Open device by path.

Parameters:

pDevicePath	the device path to be opened
pFt260Handle	Pointer to a variable of type FT260_HANDLEwhere the handle will be stored. This handle must be used to access the device.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.8 FT260_Close

FT260_STATUS **FT260_Close**(FT260_HANDLE ft260Handle)

Summary:

Close the device.

Parameters:

ft260Handle	Handle of the device.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.9 FT260_GetChipVersion

FT260_STATUS **FT260_GetChipVersion**(FT260_HANDLEft260Handle, LPDWORD lpdwChipVersion)

Summary:

Get the chip version of the FT260 device.

Version 1.0.0.0 is shows as 16777216 in decimal.

Parameters:

ft260Handle	Handle of the device.
lpdwChipVersion	Pointer to a variable for retrieving the chip version.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.10 FT260_GetLibVersion

FT260_STATUS **FT260_GetLibVersion**(LPDWORD lpdwLibVersion)

Summary:

Get the library version of the FT260 support library.

Parameters:

lpdwLibVersion	Pointer to a variable for retrieving the library version.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.11 FT260_SetClock

FT260_STATUS **FT260_SetClock** FT260_SetClock(FT260_HANDLEft260Handle, FT260_Clock_Rate clk)

Summary:

Set system clock rate. The default clock rate of the FT260 is 48 MHz.

A lower system clock rate will have lower power consumption, and it may also affect maximum transfer rates.

Parameters:

ft260Handle	Handle of the device.
Clk	System clock rate: • FT260_SYS_CLK_12M • FT260_SYS_CLK_24M • FT260_SYS_CLK_48M

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.12 FT260_SetWakeupInterrupt

FT260_STATUS **FT260_SetWakeupInterrupt**(FT260_HANDLEft260Handle, BOOL enable)

Summary:

Enable/Disable wakeup interrupt.

Parameters:

ft260Handle	Handle of the device.

enable	TRUE to enable and switch the pin mode to wakeup/interrupt FALSE to disable and switch the pin mode to GPIO3

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.13 FT260_SetInterruptTriggerType

FT260_STATUS **FT260_SetInterruptTriggerType**(FT260_HANDLEft260Handle, FT260_Interrupt_Trigger_Type type, FT260_Interrupt_Level_Time_Delay delay)

Summary:

Specify edge, level and duration of signals to generate interrupt.

Parameters:

ft260Handle	Handle of the device.
type	Trigger type: • FT260_INTR_RISING_EDGE • FT260_INTR_LEVEL_HIGH • FT260_INTR_FALLING_EDGE • FT260_INTR_LEVEL_LOW
delay	Specifies the minimum pulse width for level-based interrupts. When the voltage at the interrupt pin exceeds the level for the specified duration, the interrupt signal will be generated. This setting only affects trigger types that are level high or level low. • FT260_INTR_DELAY_1MS • FT260_INTR_DELAY_5MS • FT260_INTR_DELAY_30MS

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.14 FT260_SelectGpio2Function

FT260_STATUS **FT260_SelectGpio2Function**(FT260_HANDLE ft260Handle, FT260_GPIO2_Pin gpio2Function)

Summary:

Select the function of GPIO 2.

Parameters:

ft260Handle	Handle of the device.
gpio2Function	Set the active function of the pin GPIO2: • FT260_GPIO2_GPIO GPIO 2, General Purpose I/O. • FT260_GPIO2_SUSPOUT

	SUSPOUT_N is the default functions to indicate entering the USB suspend state. Active Low. It can be configured as active high. • FT260_GPIO2_PWREN PWREN_N is as the power enable indicator when the FT260 is USB enumerated. Active Low. • FT260_GPIO2_TX_LED TX_LED is the LED driving source when data is transmitted on the UART TX port.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.15 FT260_SelectGpioAFunction

FT260_STATUS **FT260_SelectGpioAFunction**(FT260_HANDLE ft260Handle, FT260_GPIOA_Pin gpioAFunction)

Summary:

Select the function of GPIO A.

Parameters:

ft260Handle	Handle of the device.
gpioAFunction	Set the active function of the pin GPIOA: • FT260_GPIOA_GPIO GPIO A, General Purpose I/O. • FT260_GPIOA_TX_ACTIVE TX_ACTIVE is the default function to indicate the UART transmitting is active. • FT260_GPIOA_TX_LED TX_LED is the LED driving source when data is transmitted on the UART TX port.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.16 FT260_SelectGpioGFunction

FT260_STATUS **FT260_SelectGpioGFunction**(FT260_HANDLE ft260Handle, FT260_GPIOG_Pin gpioGFunction)

Summary:

Select the function of GPIO G.

Parameters:

ft260Handle	Handle of the device.
gpioGFunction	Set the active function of the pin GPIOG:

	• FT260_GPIOG_GPIO GPIO G, General Purpose I/O. • FT260_GPIOG_PWREN PWREN_N is the power enable indicator when the FT260 is USB enumerated. Active low. • FT260_GPIOG_RX_LED RX_LED is the LED driving source when data is received on the UART RX port. • FT260_GPIOG_BCD_DET BCD_DET is the default function. A battery charger detection indicator output when the device is connected to a dedicated battery charger port. Polarity can be defined.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.17 FT260_SetSuspendOutPolarity

FT260_STATUS **FT260_SetSuspendOutPolarity**(FT260_HANDLE ft260Handle, FT260_Suspend_Out_Polarity polarity)

Summary:

Set suspend out polarity.

Parameters:

ft260Handle	Handle of the device.
polarity	Suspend out level: • FT260_SUSPEND_OUT_LEVEL_HIGH • FT260_SUSPEND_OUT_LEVEL_LOW

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.18 FT260_EnableI2CPin

FT260_STATUS **FT260_EnableI2CPin**(FT260_HANDLE ft260Handle)

Summary:

Disable GPIO mode and switch pins to I2C SCK and I2C SDA.

Parameters:

ft260Handle	Handle of the device.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.19 FT260_SetUartToGPIOPin

FT260_STATUS **FT260_SetUartToGPIOPin**(FT260_HANDLE ft260Handle)

Summary:

Disable UART mode and switch pins to GPIO B, GPIO C, GPIO D, GPIO E, GPIO F and GPIO H.

Parameters:

ft260Handle	Handle of the device.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.20 FT260_SetGPIOToUartPin

FT260_STATUS **FT260_SetGPIOToUartPin**(FT260_HANDLE ft260Handle)

Summary:

Disable GPIO mode and switch pins to UART TXD and UART RXD.

Parameters:

ft260Handle	Handle of the device.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.21 FT260_EnableDcdRiPin

FT260_STATUS **FT260_EnableDcdRiPin**(FT260_HANDLE ft260Handle, BOOL enable)

Summary:

Set UART DCD, RI function and switch pin function.

Parameters:

ft260Handle	Handle of the device.
enable	FALSE to disable UART DCD, UART RI, and switch the pins modes to GPIO4, GPIO5 TRUE to enable and switch the pins modes to UART DCD, UART RI

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.22 FT260_SetParam_U8

FT260_STATUS **FT260_SetParam_U8** (FT260_HANDLE ft260Handle, FT260_PARAM_1 param, uint8 value)

Summary:

Set pin configuration values via parameter.

Parameters:

ft260Handle	Handle of the device.
Param & value	Param : FT260_DS_CTL0 Set driving strength of pins tx_active: bit[1:0], uart_dsr_n: bit[3:2], uart_dtr_n: bit[5:4] 00b: 4ma 01b: 8ma 10b: 12ma 11b: 16ma Bit 6 : always 0 Bit 7 : always 0
	Param : FT260_DS_CTL3 Set driving strength of pins One-wire debugger: bit[1:0], bcd_det: bit[3:2] 00b: 4ma 01b: 8ma 10b: 12ma 11b: 16ma Bit 4 : set true (1b) for weak pulling up uart_dsr_n pin Bit 5 : set true (1b) for weak pulling down uart_dsr_n pin Bit 6 : always 0 Bit 7 : always 0
	Param : FT260_DS_CTL4 Set driving strength of pins uart_rts: bit[1:0], uart_cts: bit[3:2], uart_rxd: bit[5:4] , uart_txd: bit[7:6] 00b: 4ma 01b: 8ma 10b: 12ma 11b: 16ma
	Param : FT260_SR_CTL0 Set true (1b) for enable slew rate control Bit 0 : tx_ac

	Bit 1 : uart_rts Bit 2 : uart_cts Bit 3 : uart_dtr Bit 4 : uart_rxd Bit 5 : uart_txd Bit 6 : always 0 Bit 7 : always 0
	Param : FT260_GPIO_PULL_UP Set true (1b) for weak pulling up gpio pins: Bit 0 : gpio0 Bit 1 : gpio1 Bit 2 : gpio2 Bit 3 : gpio3 Bit 4 : gpio4 Bit 5 : gpio5 Bit 6 : always 0 Bit 7 : always 0
	Param : FT260_GPIO_OPEN_DRAIN Set true (1b) for enable open drains GPIO pins Bit 0 : gpio0 Bit 1 : gpio1 Bit 2 : gpio2 Bit 3 : gpio3 Bit 4 : gpio4 Bit 5 : gpio5 Bit 6 : always 0 Bit 7 : always 0
	Param : FT260_GPIO_PULL_DOWN Set true (1b) for weak pulling down GPIO pins: Bit 0 : gpio0 Bit 1 : gpio1 Bit 2 : gpio2 Bit 3 : gpio3 Bit 4 : gpio4 Bit 5 : gpio5 Bit 6 : always 0 Bit 7 : always 0
	Param : FT260_GPIO_GPIO_SLEW_RATE Set true (1b) for enable slew rate control

	Bit 0 : gpio0 Bit 1 : gpio1 Bit 2 : gpio2 Bit 3 : gpio3 Bit 4 : gpio4 Bit 5 : gpio5 Bit 6 : always 0 Bit 7 : always 0

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.1.23 FT260_SetParam_U16

FT260_STATUS **FT260_SetParam_U16** (FT260_HANDLE ft260Handle, FT260_PARAM_2 param, uint16 value)

Summary:

Set pin configuration values via parameter.

Parameters:

ft260Handle	Handle of the device.
Param & value	Param : FT260_GPIO_GROUP_SUSPEND_0 Pins status in suspend mode GPIO0: bit[1:0], GPIO1: bit[3:2], GPIO2: bit[5:4] , GPIO3: bit[7:6], GPIO4: bit[9:8] , GPIO5: bit[11:10] 00b: no change 01b: input 10b: pull low 11b: pull high Bit 12 : always 0 Bit 13 : always 0 Bit 14 : always 0 Bit 15 : always 0
	Param : FT260_GPIO_GROUP_SUSPEND_A Pins status in suspend mode GPIOA: bit[1:0], GPIOB: bit[3:2], GPIOC: bit[5:4] , GPIOD: bit[7:6], GPIOE: bit[9:8] , GPIOF: bit[11:10] , GPIOG: bit[13:12] , GPIOH: bit[15:14] 00b: no change 01b: input 10b: pull low

	11b: pull high
	Param : FT260_GPIO_DRIVE_STRENGTH Set driving strength of pins GPIO0: bit[1:0], GPIO1: bit[3:2], GPIO2: bit[5:4] , GPIO3: bit[7:6], GPIO4: bit[9:8], GPIO5: bit[11:10] 00b: 4ma 01b: 8ma 10b: 12ma 11b: 16ma Bit 12 : always 0 Bit 13 : always 0 Bit 14 : always 0 Bit 15 : always 0

Return Value:

FT260_OK if successful, otherwise the return value is an error code

4.2 I²C Master Functions

I²C (Inter Integrated Circuit) is a multi-master serial bus invented by Philips. I²C uses two bi-directional open-drain wires called serial data (SDA) and serial clock (SCL). Common I²C bus speeds are the 100 kbit/s standard mode (SM), 400 kbit/s fast mode (FM), 1 Mbit/s Fast mode plus (FM+), and 3.4 Mbit/s High Speed mode (HS).

I²C transaction

All I²C transactions begin with a START condition, a slave address, a single bit representing write (0) or read (1), and are terminated by a STOP condition. All of them are always generated by the master.

Start	7 bit slave address	Write	ACK	8 bit data	ACK	8 bit data	ACK	8 bit data	ACK	STOP

Start	7 bit slave address	Read	ACK	8 bit data	ACK	8 bit data	ACK	8 bit data	NACK	STOP

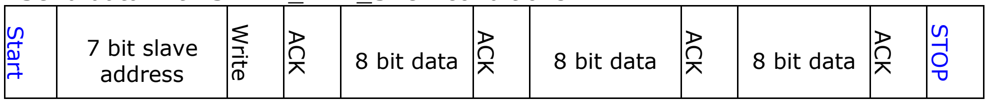
I²C defines three basic types of message:

- Single message where a master writes data to a slave;
- Single message where a master reads data from a slave;
- Combined messages, where a master issues at least two reads and/or writes to one or more slaves

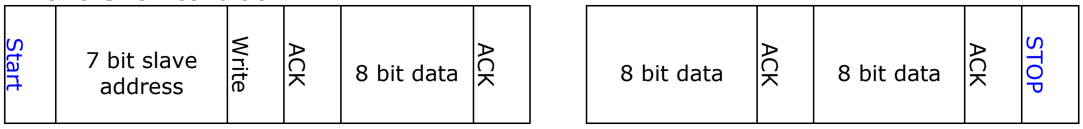
For more information on the protocol, refer to the I²C specification.

The FT260 provides flexibility to allow users to decide when to send START and STOP conditions. Here are some examples. The following scenarios are supported by the FT260.

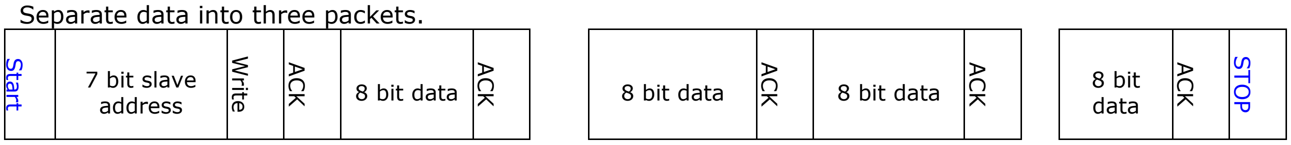
Send data with START_AND_STOP conditions



Send the first packet with a START condition, and then send remaining data in the other packet with a STOP condition.

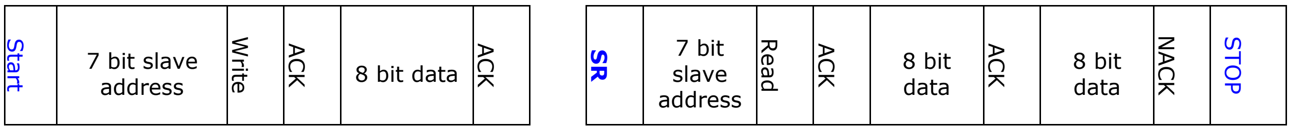


Separate data into three packets.



I²C combined message

In a combined message, each read or write begins with a START and the slave address. After the first START, these are called repeated START bits; repeated START bits are not preceded by STOP bits, which is how slaves know the next transfer is part of the same message.



SR = repeated START condition

4.2.1 FT260_I2CMaster_Init

FT260_STATUS **FT260_I2CMaster_Init**(FT260_HANDLE ft260Handle, uint32 kbps)

Summary:

Initialize the FT260 as an I²C master with the requested I²C clock speed.

Parameters:

ft260Handle	Handle of the device.
kbps	The speed of the I²C clock, whose range is from 100 Kbps to 4000 Kbps.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.2.2 FT260_I2CMaster_Reset

FT260_STATUS **FT260_I2CMaster_Reset**(FT260_HANDLE ft260Handle)

Summary:

Reset the FT260 I²C Master controller.

Parameters:

ft260Handle	Handle of the device.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.2.3 FT260_I2CMaster_Write

FT260_STATUS **FT260_I2CMaster_Write**(FT260_HANDLE ft260Handle, uint8 deviceAddress, FT260_I2C_FLAG flag, LPVOID lpBuffer, DWORD dwBytesToWrite, LPDWORD lpdwBytesWritten);

Summary:

Write data to the specified I2C slave device with the given I^{2}C condition.

Parameters:

ft260Handle	Handle of the device.
deviceAddress	Address of the target I^{2}C slave.
flag	I^{2}C condition: • FT260_I2C_NONE • FT260_I2C_START • FT260_I2C_REPEATED_START • FT260_I2C_STOP • FT260_I2C_START_AND_STOP
lpBuffer	Pointer to the buffer that contains the data to be written to the device.
dwBytesToRead	Number of bytes to write to the device.
lpdwBytesReturned	Pointer to a variable of type DWORD which receives the number of bytes read and written to the device.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.2.4 FT260_I2CMaster_Read

FT260_STATUS **FT260_I2CMaster_Read**(FT260_HANDLE ft260Handle, uint8 deviceAddress, FT260_I2C_FLAG flag, LPVOID lpBuffer, DWORD dwBytesToRead, LPDWORD lpdwBytesReturned, DWORD wait_timer)

Summary:

Read data from the specified I2C slave device with the given I^{2}C condition.

Parameters:

ft260Handle	Handle of the device.
deviceAddress	Address of the target I^{2}C slave device.
Flag	I^{2}C condition:

	• FT260_I2C_NONE • FT260_I2C_START • FT260_I2C_REPEATED_START • FT260_I2C_STOP • FT260_I2C_START_AND_STOP
lpBuffer	Pointer to the buffer that receives the data from the device.
dwBytesToRead	Number of bytes to read from the device.
lpdwBytesReturned	Pointer to a variable of type DWORD which receives the number of bytes read from the device.
wait_timer	A timer counter to check I2C read status from the device If times up, the I2C will return an error message FT260_I2C_READ_FAIL The default value is 5000(5 sec)

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.2.5 FT260_I2CMaster_GetStatus

FT260_STATUS **FT260_I2CMaster_GetStatus**(FT260_HANDLE ft260Handle, uint8* status)

Summary:

Read the status of the I2C master controller.

Parameters:

ft260Handle	Handle of the device.
Status	Point to a variable of type uint8 which saves the status value. Status: • bit 0 = controller busy: all other status bits invalid • bit 1 = error condition • bit 2 = slave address was not acknowledged during last operation • bit 3 = data not acknowledged during last operation • bit 4 = arbitration lost during last operation • bit 5 = controller idle • bit 6 = bus busy

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.3 UART Functions

UART (Universal Asynchronous Receiver/Transmitter) is a commonly used interface to transfer serial data. Being asynchronous there is no clock signal but the structure of the transmitted data provides for a start and an end to a message. It is also important that both ends of the link decide to operate with the same pulse width defined as the baud rate. The UART of a micro-controller will normally operate at 3V3 or 5V TTL levels. The UART will only connect to one other device in the chain.

The FT260 device can be initialized as a UART. Here is a brief overview of FT260 UART features:

- The UART can support baud rates from 1.2KBaud to 12MBaud.
- UART data signals: TxD, RxD, RTS, CTS, DSR, DTR, DCD, RI, GND
- Serial Communication Parameters
    - Parity: None, Odd, Even, Mark, Space
    - Data bits: 7, 8
    - Flow control: RTS/CTS , DSR/DTR, X-ON/X-OFF, None
    - Stop bits 1,2

Please refer to datasheet FT260 HID Class USB to UART/I2C Master for more information.

4.3.1 FT260_UART_Init

FT260_STATUS **FT260_UART_Init**(FT260_HANDLE ft260Handle);

Summary:

Initialize the FT260 as a UART device.

Parameters:

ft260Handle	Handle of the device.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.3.2 FT260_UART_Reset

FT260_STATUS **FT260_UART_Reset**(FT260_HANDLE ft260Handle)

Summary:

Reset UART controller.

Parameters:

ft260Handle	Handle of the device.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.3.3 FT260_UART_SetBaudRate

FT260_STATUS **FT260_UART_SetBaudRate**(FT260_HANDLE ft260Handle, ULONG baudRate)

Summary:

Set the baud rate for the device.

Parameters:

ft260Handle	Handle of the device.
baudRate	The speed of UART transmission. It ranges from 1,200 to 12,000,000 bps.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.3.4 FT260_UART_SetFlowControl

FT260_STATUS **FT260_UART_SetFlowControl**(FT260_HANDLE ft260Handle, FT260_UART_Mode flowControl)

Summary: Set UART flow control for the device.

Parameters:

ft260Handle	Handle of the device.
flowControl	Flow control: • FT260_UART_OFF: Disable UART and switch UART pins to GPIO. • FT260_UART_RTS_CTS_MODE • FT260_UART_DTR_DSR_MODE • FT260_UART_XON_XOFF_MODE • FT260_UART_NO_FLOW_CTRL_MODE

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.3.5 FT260_UART_SetDataCharacteristics

FT260_STATUS **FT260_UART_SetDataCharacteristics**(FT260_HANDLE ft260Handle, FT260_Data_Bit dataBits, FT260_Stop_Bit stopBits, FT260_Parity parity);

Summary:

Set UART data characteristics for the device.

Parameters:

ft260Handle	Handle of the device.
dataBits	Data bits: • FT260_DATA_BIT_7 • FT260_DATA_BIT_8
stopBits	Stop bits: • FT260_STOP_BITS_1 • FT260_STOP_BITS_2

parity	Parity: • FT260_PARITY_NONE • FT260_PARITY_ODD • FT260_PARITY_EVEN • FT260_PARITY_MARK • FT260_PARITY_SPACE

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.3.6 FT260_UART_SetBreakOn

FT260_STATUS **FT260_UART_SetBreakOn**(FT260_HANDLE ft260Handle)

Summary:

Set the BREAK condition ON for the device.

Parameters:

ft260Handle	Handle of the device.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.3.7 FT260_UART_SetBreakOff

FT260_STATUS **FT260_UART_SetBreakOff**(FT260_HANDLE ft260Handle)

Summary:

Reset the BREAK condition OFF for the device.

Parameters:

ft260Handle	Handle of the device.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.3.8 FT260_UART_GetConfig

FT260_STATUS **FT260_UART_GetConfig**(FT260_HANDLE ft260Handle, UartConfig* pUartConfig)

Summary:

UART get configuration which includes baud rate, data characteristics and break condition.

Parameters:

ft260Handle	Handle of the device.

pUartConfig	Pointer to a variable of type UartConfig where the value will be stored. Type UartConfig is defined as following:
	struct UartConfig
	{
	u8 flow_ctrl;
	u32 baud_rate;
	u8 data_bit;
	u8 parity;
	u8 stop_bit;
	u8 breaking;
	}
	
	Please refer to the previous UART setting functions for a description of the fields.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.3.9 FT260_UART_SetXonXoffChar

FT260_STATUS **FT260_UART_SetXonXoffChar**(FT260_HANDLE ft260Handle, UCHAR Xon, UCHAR Xoff)

Summary: Set Xon/Xoff characters for software flow control.

Software flow control (XON_XOFF)

This setting uses special characters to start and stop data flow. These are termed XON and XOFF (from "transmit on" and "transmit off", respectively). The XON character tells the downstream device to start sending data. The XOFF character tells the downstream device to stop sending data. Usually it is possible to define these characters in an application. Typical default for XON is 0x11 and for XOFF is 0x13.

Parameters:

ft260Handle	Handle of the device.
Xon	Setting character for transmit on.
Xoff	Setting character for transmit off.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.3.10 FT260_UART_GetQueueStatus

FT260_STATUS **FT260_UART_GetQueueStatus**(FT260_HANDLE ft260Handle, LPDWORD lpdwAmountInRxQueue)

Summary:

Gets the number of bytes in the receive queue.

Parameters:

ft260Handle	Handle of the device.
lpdwAmountInRxQueue	Pointer to a variable of type DWORD which save the amount of data.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.3.11 FT260_UART_Write

FT260_STATUS **FT260_UART_Write**(FT260_HANDLE ft260Handle, LPVOID lpBuffer, DWORD dwBufferLength, DWORD dwBytesToWrite, LPDWORD lpdwBytesWritten)

Summary:

UART write data to the device.

Parameters:

ft260Handle	Handle of the device.
lpBuffer	Pointer to the buffer that contains the data to be written.
dwBufferLength	The length of the buffer.
dwBytesToWrite	Number of bytes to write.
lpdwBytesWritten	Pointer to a variable of type DWORD which receives the number of bytes written.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.3.12 FT260_UART_Read

FT260_STATUS **FT260_UART_Read**(FT260_HANDLE ft260Handle, LPVOID lpBuffer, DWORD dwBufferLength, DWORD dwBytesToRead, LPDWORD lpdwBytesReturned)

Summary:

UART read data from the device.

Parameters:

ft260Handle	Handle of the device.
lpBuffer	Pointer to the buffer that contains the data to be read.
dwBufferLength	The length of the buffer.
dwBytesToWrite	Number of bytes to read.
lpdwBytesWritten	Pointer to a variable of type DWORD which receives the number of bytes read.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.3.13 FT260_UART_GetDcdRiStatus

FT260_STATUS **FT260_UART_GetDcdRiStatus**(FT260_HANDLE ft260Handle, uint8* value)

Summary:

Get DCD, RI status.

Parameters:

ft260Handle	Handle of the device.
Value	Pointer to a variable of type uint8 which saves the status value. • BIT 0: DCD status • BIT 1: RI status

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.3.14 FT260_UART_EnableRiWakeup

FT260_STATUS **FT260_UART_EnableRiWakeup**(FT260_HANDLE ft260Handle, BOOL enable)

Summary:

UART enable RI wakeup.

Parameters:

ft260Handle	Handle of the device.
Enable	FALSE to disable. TRUE to enable.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.3.15 FT260_UART_SetRiWakeupConfig

FT260_STATUS **FT260_UART_SetRiWakeupConfig**(FT260_HANDLE ft260Handle, FT260_RI_wakeup_Type type)

Summary:

UART set RI wakeup configuration.

Parameters:

ft260Handle	Handle of the device.
type	Type: • FT260_RI_WAKEUP_RISING_EDGE • FT260_RI_WAKEUP_FALLING_EDGE

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.3.16 FT260_GetInterruptFlag

FT260_STATUS **FT260_GetInterruptFlag**(FT260_HANDLE ft260Handle, BOOL* pbFlag);

Summary:

Get interrupt flag.

Parameters:

ft260Handle	Handle of the device.
pbFlag	Pointer to a variable of type BOOL which saves the flag value.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.3.17 FT260_CleanInterruptFlag

FT260_STATUS **FT260_CleanInterruptFlag**(FT260_HANDLE ft260Handle, BOOL* pbFlag);

Summary:

Clean the interrupt flag.

Parameters:

ft260Handle	Handle of the device.
pbFlag	Pointer to a variable of type BOOL which saves the flag value.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.4 GPIO Functions

The FT260 contains 14 GPIO pins. Each GPIO pin is multiplexed with other functions as listed below:

- GPIO0 / SCL
- GPIO1 / SDA
- GPIO2 / SUSPEND OUT / TX_LED / PWREN
- GPIO3 / WAKEUP / INTR
- GPIO4 / UART DCD
- GPIO5 / UART RI
- GPIOA / TX_ACTIVE / TX_LED / PWREN
- GPIOB / UART_RTS_N

- GPIOC / UART_RXD
- GPIOD / UART_TXD
- GPIOE / UART_CTS_N
- GPIOF / UART_DTR_N
- GPIOG / BCD_DET / RX_LED
- GPIOH / UART_DST_N

The LibFT260 support library provides several APIs to set the function of these GPIOs and the GPIO example application shows how to use them.

Please refer to datasheet FT260 HID Class USB to UART/I2C Master for more information.

4.4.1 FT260_GPIO_Set

FT260_STATUS **FT260_GPIO_Set**(FT260_HANDLE ft260Handle, FT260_GPIO_Report report)

Summary:

Set directions and values for all GPIO pins with the FT260_GPIO_Report parameter.

Parameters:

ft260Handle	Handle of the device.

report	The setting values which is a variable of type FT260_GPIO_Report. Type FT260_GPIO_Report is defined as follows:
	struct FT260_GPIO_Report
	{
	    WORD value; // bit0~5: GPIO0~5 values
	    WORD dir; // bit0~5: GPIO0~5 directions
	    WORD gpioN_value; // bit6~13: GPIOA~H values
	    WORD gpioN_dir; // bit6~13: GPIOA~H directions
	}

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.4.2 FT260_GPIO_Get

FT260_STATUS **FT260_GPIO_Get**(FT260_HANDLE ft260Handle, FT260_GPIO_Report *report)

Summary:

Get directions and values for all GPIO pins with the FT260_GPIO_Report parameter.

Parameters:

ft260Handle	Handle of the device.
report	Pointer to a variable of type FT260_GPIO_Report where the value will be stored.

	Type FT260_GPIO_Report is defined as follows:
	struct FT260_GPIO_Report
	{
	WORD value; // bit0~5: GPIO0~5 values
	WORD dir; // bit0~5: GPIO0~5 directions
	WORD gpioN_value; // bit6~13: GPIOA~H values
	WORD gpioN_dir; // bit6~13: GPIOA~H directions
	}

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.4.3 FT260_GPIO_SetDir

FT260_STATUS **FT260_GPIO_SetDir**(FT260_HANDLE ft260Handle, WORD pinNum, BYTE dir)

Summary:

Set direction for the specified GPIO pin.

Parameters:

ft260Handle	Handle of the device.
pinNum	Target GPIO pin number.
dir	0 for input. 1 for output.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.4.4 FT260_GPIO_Read

FT260_STATUS **FT260_GPIO_Read**(FT260_HANDLE ft260Handle, WORD pinNum, BYTE* pValue)

Summary:

Read the value from the specified GPIO pin.

Parameters:

ft260Handle	Handle of the device.
pinNum	Target GPIO pin number.
pValue	Pointer to a variable of BYTE which receives the value of the GPIO pin.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.4.5 FT260_GPIO_Write

FT260_STATUS **FT260_GPIO_Write**(FT260_HANDLE ft260Handle, WORD pinNum, BYTE value)

Summary:

Write value to the specified GPIO pin.

Parameters:

ft260Handle	Handle of the device.
pinNum	Target GPIO pin number.
value	The output value.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.4.6 FT260_GPIO_Set_OD

FT260_STATUS **FT260_GPIO_Set_OD**(FT260_HANDLE ft260Handle, BYTE pinNum)

Summary:.

Function to enable open drain feature. The pins for operation are defined with the parameter pinNum.

It is important to note that once this feature is enabled, the **FT260_GPIO_Reset_OD** must be called when the pin is to be configured for other purposes.

Parameters:

ft260Handle	Handle of the device.

pinNum	Target GPIO pins number :
	Ex :
	1. Open drain enable at GPIO 0~5.
	GPIO_0 = 0x01;
	GPIO_1 = 0x01<<1;
	GPIO_2 = 0x01<<2;
	GPIO_3 = 0x01<<3;
	GPIO_4 = 0x01<<4;
	GPIO_5 = 0x01<<5;
	pinNum = (GPIO_0 | GPIO_1 | GPIO_2 | GPIO_3 | GPIO_4 | GPIO_5)

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

4.4.7 FT260_GPIO_Reset_OD

FT260_STATUS FT260_GPIO_Reset_OD(FT260_HANDLE handle)

Summary:.

To RESET open drain function

ft260Handle	Handle of the device.

Return Value:

FT260_OK if successful, otherwise the return value is an error code.

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Appendix A – References

Document References

FT260 HID class USB to UART/I2C Master

Acronyms and Abbreviations

Terms	Description
GPIO	General-purpose input/output
HID	Humber Interface Device
I2C	Inter-Integrated Circuit
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
USB-IF	USB Implementers Forum

Appendix B – List of Tables & Figures

List of Tables

List of Figures

Appendix C – FT260_STATUS

```
FT260_STATUS
      FT260_OK = 0
      FT260_INVALID_HANDLE = 1
      FT260_DEVICE_NOT_FOUND = 2
      FT260_DEVICE_NOT_OPENED = 3
      FT260_DEVICE_OPEN_FAIL = 4
      FT260_DEVICE_CLOSE_FAIL = 5
      FT260_INCORRECT_INTERFACE = 6
      FT260_INCORRECT_CHIP_MODE = 7
      FT260_DEVICE_MANAGER_ERROR = 8
      FT260_IO_ERROR = 9
      FT260_INVALID_PARAMETER = 10
      FT260_NULL_BUFFER_POINTER = 11
      FT260_BUFFER_SIZE_ERROR = 12
      FT260_UART_SET_FAIL = 13
      FT260_RX_NO_DATA = 14
      FT260_GPIO_WRONG_DIRECTION = 15
      FT260_INVALID_DEVICE = 16
      FT260_I2C_READ_FAIL = 17
      FT260_OTHER_ERROR = 18
```

Appendix D – Revision History

Document Title:	AN_395 User Guide for LibFT260
Document Reference No.:	FT_001280
Clearance No.:	FTDI#489
Product Page:	https://ftdichip.com/product-category/products/ic/
Document Feedback:	Send Feedback

Revision	Changes	Date
1.0	Initial Release	08-03-2016
1.1	Updated document for information related to Open drain	06-10-2017
1.2	Fix editor issue on Code example at Page 9	31-08-2018
1.3	Added the following APIs - FT260_SetParam_U8; FT260_SetParam_U16; FT260_OpenBySerialNumber; FT260_OpenByProductDescription; FT260_SetGPIOToUartPin; FT260_UART_SetRiWakeupConfig	18-04-2022
1.4	Corrected section 4.4 FT260_GPIO_Report Define	06-09-2024