Application Note

AN_561

Using Linux I2C Tools with HID FT260

Version 1.0

Issue Date: 27-11-2023

This document shows how to use the new HID-FT260 library in the latest Linux kernel. This library was designed to easily implement I2C communication with the FT260 IC.
Table of Contents

1 Introduction .............................................................................................................. 4
  1.1 Overview ........................................................................................................... 4
  1.2 Scope ................................................................................................................ 4

2 Hardware and Software Requirements ......................................................... 5
  2.1 Linux OS for HID-FT260 ............................................................................... 5
  2.2 Linux Software Required ............................................................................ 5
  2.3 FTDI Hardware Required ............................................................................ 5
  2.4 Miscellaneous Hardware ............................................................................ 5

3 Hardware Setup .................................................................................................... 6
  3.1 UMFT260EV1 and 24AA02 EEPROM Breadboard .................. 6
  3.2 UMFT260EV1 and 24AA02/24LC02 EEPROM Schematic ............ 7

4 Linux I2C Utilities and HID-FT260 ............................................................... 8
  4.1 Basic Commands ............................................................................................ 8
    4.1.1 i2cdetect ................................................................................................. 8
    4.1.2 i2cdump ................................................................................................ 10
    4.1.3 i2cset/i2cget ......................................................................................... 10
    4.1.4 i2ctransfer ............................................................................................ 11

5 Conclusion ............................................................................................................. 12

6 Contact Information .......................................................................................... 13

Appendix A – References .................................................................................... 14
  Document References ...................................................................................... 14
  Acronyms and Abbreviations ......................................................................... 14

Appendix B – List of Tables and Figures ......................................................... 15
  List of Tables .................................................................................................... 15
  List of Figures .................................................................................................. 15
1 Introduction

This document illustrates how to use the HID-FT260 driver built into the latest Linux kernels to configure the FTDI FT260 in I2C mode.

1.1 Overview

Until recently, implementing USB to I2C with the FT260 in Linux required detailed knowledge of FT260 opcodes and familiarity with complex HID IOCTL commands. With the addition of the HID-FT260 driver into the latest Linux kernels, this process can now be handled by a simple command line interface.

1.2 Scope

This document shows the user how to use the HID-FT260 driver in Linux to implement a USB to I2C Master bridge using Linux I2C tools. Other FT260 features such as UART and GPIO are not covered in this document. Refer to AN_394 User Guide for FT260 for details on how to control the FT260 IC with raw HID class commands for UART and GPIO control.
2 Hardware and Software Requirements

2.1 Linux OS for HID-FT260

For HID-FT260 driver support, ensure the Linux installation is running kernel version 5.15 or later. Ubuntu release 22.04 LTS was used for the examples in this document. To verify your kernel version, use the following command:

```
uname -r <enter>
```

2.2 Linux Software Required

Download the Linux I2C utilities to run the examples in this document. Once installed, you can use Linux man pages for more details about the I2C commands.

Use the following command in Terminal window:

```
sudo apt install i2c-tools <enter>
```

2.3 FTDI Hardware Required

UMFT260EV1A development module as shown in Figure 2.1.

![Figure 2.1 UMFT260EV1A](image)

2.4 Miscellaneous Hardware

- Microchip 24AA02 2K I2C Serial EEPROM
- 10K 1/4-watt resistors for I2C pullups
- Breadboard
3 Hardware Setup

3.1 UMFT260EV1 and 24AA02 EEPROM Breadboard

Figure 3.1 shows the simple connections between the UMFT260EV1 & 24AA02 EEPROM.

![Image of UMFT260EV1 + EEPROM Breadboard]

Figure 3.1 UMFT260EV1 + EEPROM Breadboard
3.2 UMFT260EV1 and 24AA02/24LC02 EEPROM Schematic

Figure 3.2 shows the schematic diagram of the picture shown in the previous section.

Figure 3.2 FT260 + I2C Serial EEPROM Circuit Schematic
4 Linux I2C Utilities and HID-FT260

4.1 Basic Commands

The basic Linux I2C commands covered in this document are:

- `i2cdetect`
- `i2cdump`
- `i2cset`
- `i2cget`
- `i2ctransfer`

These commands will be used with the UMFT260EV + 24AA02 EEPROM hardware setup described in Section 3 Hardware Setup.

All commands are used with a Linux terminal window.

4.1.1 `i2cdetect`

The first task is to show all the I2C devices present on the bus and identify the FT260 device.

With the UMFT260 setup and plugged in, open a Linux terminal window. The `-l` (lower case 'L') argument will list all I2C controllers on the Linux PC.

Enter the following command as shown in Figure 4.1.

```
sudo i2cdetect -l <ret>
```

![i2cdetect -l command](image)

*Figure 4.1 i2cdetect -l command*

The results of this command indicate the bus name of the FT260 is **i2c-1**.

All Linux I2C command examples will refer to this as bus 1.
**Note:** You can implement the I2C commands without the "sudo" (super user) prefix by going to the /dev directory and changing the permissions of the i2c-* device assigned to the FT260 as shown in the previous screenshot.

```
cd /dev <ret>
sudo chmod 777 i2c-*  <ret>
```

This will allow you to run the Linux I2C commands as a normal user.

To find the I2C Slave address of I2C slaves connected to the FT260 you can use the `i2cdetect` command with the `-y` option to show all the I2C slave addresses connected to the FT260 i2c bus, i2c-1 as shown in Figure 4.2.

```
i2cdetect -y 1 <ret>
```

![Figure 4.2 i2cdetect -y 1 command](image)

For the command demonstrations in this app note, I2C slave address 0x51 will be used.
4.1.2 i2cdump

This command is used to dump all the data from any attached I2C slave device. The following command will show the contents of the empty 24AA02 serial EEPROM at slave address 0x51. The entire 256 x 8-bit address space will be listed as shown in Figure 4.3.

```
i2cdump -y 1 0x51 <ret>
```

![Figure 4.3 i2cdump command](image)

4.1.3 i2cset/i2cget

This command is used to assign data to a given address on the I2C Slave device. The bus number of the FTDI device must be specified and the target address / data.

In this example, we write hex 0x46 to address 0x00 in the EEPROM and read the result from address 0x00 as shown in Figure 4.4.

```
i2cset -y 1 0x51 0x00 0x46 <ret>
i2cget -y 1 0x51 0x00 <ret>
```

![Figure 4.4 i2cset/i2cget commands](image)
### 4.1.4 i2ctransfer

You can transfer up to 8 bytes of data to the I2C slave using this command. The following command shows how to write 8 bytes of data starting at address offset 0.

```
i2ctransfer -y 1 w9@0x51 0 0x46 0x54 0x20 0x32 0x36 0x30 0x20 0x4c 0x69 <ret>
```

**Note:** The w9 argument specifies the address offset (1 byte) plus the total number of bytes to write (8) making this value.

Another 8 bytes of data can be sent by specifying an address offset of 9:

```
i2ctransfer -y 1 w9@0x51 9 0x6e 0x75 0x78 0x20 0x44 0x65 0x6d 0x6f <ret>
```

Confirm by sending the i2ctransfer command in read mode.

**Note:** This will read all the data written to the EEPROM including the data sent by the two i2ctransfer commands.

```
i2ctransfer -y 1 w1@0x51 0 r 16 <ret>
```

0x46 0x54 0x32 0x30 0x20 0x4c 0x69 0x6e 0x75 0x78 0x30 0x44 0x65 0x6d 0x6f

---

**Figure 4.5 i2ctransfer commands**

The i2cdump command can be used to show the contents of the first 16 addresses of the EEPROM memory as follows:

```
i2cdump -y -r 0x00-0xFF 1 0x51 <ret>
```

This will show the the ASCII characters that were written to the I2C EEPROM in the previous exercises as shown in Figure 4.6.

---

**Figure 4.6 i2cdump command showing ASCII characters**
5 Conclusion

In this document, a simple way of sending I2C data using our FT260 IC has been demonstrated for Linux using the new HID-FT260 kernel driver and the built-in Linux I2C commands.

With this utility and driver, there is no need to develop code using formal high-level programming and API calls.

The I2C utility commands can be included in a Linux batch file or C program using the system API command.

This new driver is a powerful tool for engineers who need to develop USB to I2C applications in a timely manner.
6 Contact Information

Head Office – Glasgow, UK
Future Technology Devices International Limited (UK)
Unit 1, 2 Seaward Place, Centurion Business Park
Glasgow G41 1HH
United Kingdom
Tel: +44 (0) 141 429 2777
Fax: +44 (0) 141 429 2758
E-mail (Sales) sales1@ftdichip.com
E-mail (Support) support1@ftdichip.com
E-mail (General Enquiries) admin1@ftdichip.com

Branch Office – Tigard, Oregon, USA
Future Technology Devices International Limited (USA)
7130 SW Fir Loop
Tigard, OR 97223-8160
USA
Tel: +1 (503) 547 0988
Fax: +1 (503) 547 0987
E-Mail (Sales) us.sales@ftdichip.com
E-Mail (Support) us.support@ftdichip.com
E-Mail (General Enquiries) us.admin@ftdichip.com

Branch Office – Taipei, Taiwan
Future Technology Devices International Limited (Taiwan)
2F, No. 516, Sec. 1, NeiHu Road
Taipei 114
Taiwan, R.O.C.
Tel: +886 (0) 2 8797 1330
Fax: +886 (0) 2 8751 9737
E-mail (Sales) tw.sales1@ftdichip.com
E-mail (Support) tw.support1@ftdichip.com
E-mail (General Enquiries) tw.admin1@ftdichip.com

Branch Office – Shanghai, China
Future Technology Devices International Limited (China)
Room 1103, No. 666 West Huaihai Road,
Shanghai, 200052
China
Tel: +86 21 62351596
Fax: +86 21 62351595
E-mail (Sales) cn.sales@ftdichip.com
E-mail (Support) cn.support@ftdichip.com
E-mail (General Enquiries) cn.admin@ftdichip.com

Web Site
http://ftdichip.com

Distributor and Sales Representatives
Please visit the Sales Network page of the FTDI Web site for the contact details of our distributor(s) and sales representative(s) in your country.

System and equipment manufacturers and designers are responsible to ensure that their systems, and any Future Technology Devices International Ltd (FTDI) devices incorporated in their systems, meet all applicable safety, regulatory and system-level performance requirements. All application-related information in this document (including application descriptions, suggested FTDI devices and other materials) is provided for reference only. While FTDI has taken care to assure it is accurate, this information is subject to customer confirmation, and FTDI disclaims all liability for system designs and for any applications assistance provided by FTDI. Use of FTDI devices in life support and/or safety applications is entirely at the user’s risk, and the user agrees to defend, indemnify, and hold harmless FTDI from any and all damages, claims, suits, or expense resulting from such use. This document is subject to change without notice. No freedom to use patents or other intellectual property rights is implied by the publication of this document. Neither the whole nor any part of the information contained in, or the product described in this document, may be adapted, or reproduced in any material or electronic form without the prior written consent of the copyright holder. Future Technology Devices International Ltd, Unit 1, 2 Seaward Place, Centurion Business Park, Glasgow G41 1HH, United Kingdom. Scotland Registered Company Number: SC136640
Appendix A – References

Document References

FT260 HID-class USB to UART/I2C Bridge IC Datasheet, FTDI Ltd.
UMFT260EV1A FT260 DIP Development Module, FTDI Ltd.
24AA02/24LC02B/24FC02 2K I²C Serial EEPROM, Microchip Inc.
HID-FT260 Source Code, GitHub
I²C Utilities in Linux, Sushil Rathore

Linux man pages are available for the I2C utility commands used in this document.

(man i2cget <ret>)

AN_394 User Guide for FT260
FT260Q IC Product Page
FT260S IC Product Page

Acronyms and Abbreviations

<table>
<thead>
<tr>
<th>Terms</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASCII</td>
<td>American Standard Code for Information Interchange</td>
</tr>
<tr>
<td>EEPROM</td>
<td>Electrically Erasable Programmable Read-Only Memory</td>
</tr>
<tr>
<td>GPIO</td>
<td>General Purpose Input/Output</td>
</tr>
<tr>
<td>I²C</td>
<td>Inter-Integrated Circuit Interface</td>
</tr>
<tr>
<td>IC</td>
<td>Integrated circuit</td>
</tr>
<tr>
<td>IOCTL</td>
<td>Input/output control</td>
</tr>
<tr>
<td>HID</td>
<td>Human Interface Device</td>
</tr>
<tr>
<td>HID-FT260</td>
<td>A Linux kernel level driver for the FT260, developed by Michael Zaidman of Xsight Labs.</td>
</tr>
<tr>
<td>UART</td>
<td>Universal Asynchronous Receiver/Transmitter</td>
</tr>
<tr>
<td>USB</td>
<td>Universal Serial Bus</td>
</tr>
</tbody>
</table>
Appendix B – List of Tables and Figures

List of Tables
NA

List of Figures
Figure 2.1 UMFT260EV1A.................................................................................................................. 5
Figure 3.1 UMFT260EV1 + EEPROM Breadboard........................................................................... 6
Figure 3.2 FT260 + I2C Serial EEPROM Circuit Schematic.............................................................. 7
Figure 4.1 i2cdetect -l command........................................................................................................ 8
Figure 4.2 i2cdetect -y 1 command ..................................................................................................... 9
Figure 4.3 i2cdump command............................................................................................................. 10
Figure 4.4 i2set/i2cget commands.................................................................................................... 10
Figure 4.5 i2ctransfer commands ..................................................................................................... 11
Figure 4.6 i2cdump command showing ASCII characters............................................................... 11
Appendix C – Revision History

<table>
<thead>
<tr>
<th>Revision</th>
<th>Changes</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Initial Release</td>
<td>27-11-2023</td>
</tr>
</tbody>
</table>

Document Title: AN_561 Using Linux I2C Tools with HID-FT260
Document Reference No.: FT_001546
Clearance No.: FTDI#591
Document Feedback: Send Feedback