

GM8136

# FOTG210 USB OTG DRIVER

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User Guide

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## GM8136 USB OTG User Guide

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# TABLE OF CONTENTS

Chapter 1	Introduction.....	1
	1.1 Version of the Software .....	2
	1.2 Brief Description .....	2
Chapter 2	Setup and Configuration .....	3
	2.1 FOTG210 Full-function Mode Configuration .....	4
	2.2 FOTG210 Host-only Mode Configuration.....	7
	2.3 Class Driver Configuration .....	9
	2.3.1 FOTG210 Configuration to Support Mass Storage in Host Mode.....	9
Chapter 3	Operation.....	11
	3.1 Example of USB Applications .....	12
	3.2 Mass Storage Application in Device Mode.....	12
	3.3 FOTG210 Host-mode Applications .....	13
	3.4 FOTG210 Device-mode Application – Mass Storage .....	14
	3.5 USB Auto-mount/Auto-umount.....	17
	3.6 Reference Files .....	21

# LIST OF FIGURES

Figure 2-1. FOTG210 Full-function Mode Configuration with Enabled Host Function ..... 4

Figure 2-2. FOTG210 Full-function Mode Configuration with Device Function-1 ..... 5

Figure 2-3. FOTG210 Full-function Mode Configuration with Device Function-2 ..... 6

Figure 2-4. FOTG210 Host-only Mode Configuration with Host Function..... 7

Figure 2-5. FOTG210 Host-only Mode Configuration with Device Function ..... 8

Figure 2-6. FOTG210 Configuration to Support Mass Storage in Host Mode-1 ..... 9

Figure 2-7. FOTG210 Configuration to Support Mass Storage in Host Mode-2 ..... 10



# Chapter 1

## Introduction

---

This chapter contains the following sections:

- 1.1 Version of the Software
- 1.2 Brief Description

## 1.1 Version of the Software

Software release version: 1.0.0

## 1.2 Brief Description

This driver is developed from the Linux 3.3 USB subsystem. The Linux USB subsystem includes three parts, which are the USB core driver, OTG driver, and EHCI driver. This user guide provides the information about how to use the FOTG210 Linux 3.3 drivers.



# Chapter 2

## Setup and Configuration

---

This chapter contains the following sections:

- 2.1 FOTG210 Full-function Mode Configuration
- 2.2 FOTG210 Host-only Mode Configuration
- 2.3 Class Driver Configuration

## 2.1 FOTG210 Full-function Mode Configuration

FOTG210 can be configured as the full-function mode or host-only mode. This section shows how to configure FOTG210 for the enabled host function and device function.

Enable the host function and built-in kernel.

Choose Y here: Device Drivers → USB support → EHCI HCD (USB 2.0) support → GM USB On-The-Go EHCI HCD(USB2.0) support

```
.config - Linux/arm 3.3.0 Kernel Configuration

                                USB support
Arrow keys navigate the menu. <Enter> selects submenus --->. Highlighted letters are
hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes features. Press <Esc><Esc>
to exit, <?> for Help, </> for Search. Legend: [*] built-in [ ] excluded <M> module
< > module capable

--- USB support
<*>  Support for Host-side USB
[ ]   USB verbose debug messages
[ ]   USB announce new devices
      *** Miscellaneous USB options ***
[ ]   USB device filesystem (DEPRECATED)
[*]   USB device class-devices (DEPRECATED)
[ ]   Dynamic USB minor allocation
[ ]   Rely on OTG Targeted Peripherals List
[ ]   Disable external hubs
< >  DesignWare USB3 DRD Core Support
< >  USB Monitor
< >  Support WUSB Cable Based Association (CBA)
      *** USB Host Controller Drivers ***
< >  Cypress C67x00 HCD support
<*>  EHCI HCD (USB 2.0) support
[*]   GM USB On-The-Go EHCI HCD(USB2.0) support
[ ]   Enable FOTG210 phy test on GM USB OTG2XX
v(+)
```

**<Select>**    < Exit >    < Help >

Figure 2-1. FOTG210 Full-function Mode Configuration with Enabled Host Function

Enable device function and compile driver as a module. Configure the device function as a mass storage.  
Choose M here: Device Drivers → USB support → USB Gadget Support

```
.config - Linux/arm 3.3.0 Kernel Configuration

                                USB support
Arrow keys navigate the menu. <Enter> selects submenus --->. Highlighted letters are
hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes features. Press <Esc><Esc>
to exit, <?> for Help, </> for Search. Legend: [*] built-in [ ] excluded <M> module
< > module capable

^(-)
< > USB LED driver support
< > Cypress CY7C63xxx USB driver support
< > Cypress USB thermometer driver support
< > Siemens ID USB Mouse Fingerprint sensor support
< > Elan PCMCIA CardBus Adapter USB Client
< > Apple Cinema Display support
< > USB 2.0 SVGA dongle support (Net2280/SiS315)
< > USB LD driver
< > PlayStation 2 Trance Vibrator driver support
< > IO Warrior driver support
< > USB testing driver
< > iSight firmware loading support
< > USB YUREX driver support
<M> USB Gadget Support --->
    *** OTG and related infrastructure ***
    < > GPIO based peripheral-only VBUS sensing 'transceiver'
    [ ] Generic ULPI Transceiver Driver
    < > NOP USB Transceiver Driver

                                <Select>  < Exit >  < Help >
```

Figure 2-2. FOTG210 Full-function Mode Configuration with Device Function-1

Choose "GM USB FOTG210" here: Device Drivers → USB support → USB Gadget Support → USB Peripheral Controller

Enter 0 here: Device Drivers → USB support → USB Gadget Support → Choose which FOTG210 for UDC

Choose M here: Device Drivers → USB support → USB Gadget Support → File-backed Storage Gadget

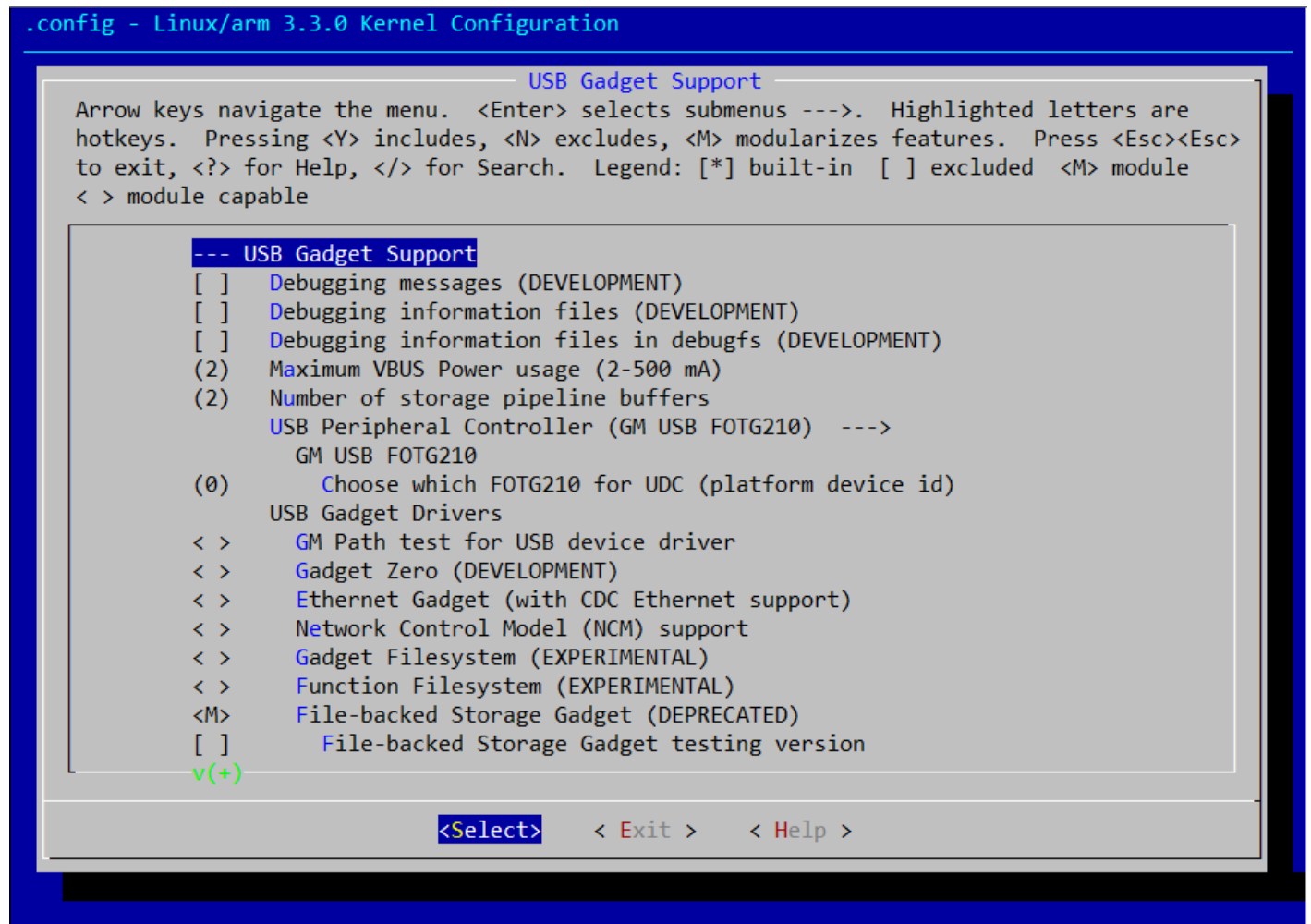


Figure 2-3. FOTG210 Full-function Mode Configuration with Device Function-2

## 2.2 FOTG210 Host-only Mode Configuration

This section shows how to configure FOTG210 to the host-only mode.

Enable the host function and built-in kernel.

Choose Y here: Device Drivers → USB support → EHCI HCD (USB 2.0) support → GM USB On-The-Go EHCI HCD(USB2.0) support

```
.config - Linux/arm 3.3.0 Kernel Configuration

                                USB support
Arrow keys navigate the menu. <Enter> selects submenus --->. Highlighted letters are
hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes features. Press <Esc><Esc>
to exit, <?> for Help, </> for Search. Legend: [*] built-in [ ] excluded <M> module
< > module capable

--- USB support
<*> Support for Host-side USB
[ ] USB verbose debug messages
[ ] USB announce new devices
*** Miscellaneous USB options ***
[ ] USB device filesystem (DEPRECATED)
[*] USB device class-devices (DEPRECATED)
[ ] Dynamic USB minor allocation
[ ] Rely on OTG Targeted Peripherals List
[ ] Disable external hubs
< > DesignWare USB3 DRD Core Support
< > USB Monitor
< > Support WUSB Cable Based Association (CBA)
*** USB Host Controller Drivers ***
< > Cypress C67x00 HCD support
<*> EHCI HCD (USB 2.0) support
[*] GM USB On-The-Go EHCI HCD(USB2.0) support
[ ] Enable FOTG210 phy test on GM USB OTG2XX
v(+)
```

**<Select>**   < Exit >   < Help >

Figure 2-4. FOTG210 Host-only Mode Configuration with Host Function

Disable the device function

Choose N here: Device Drivers → USB support → USB Gadget Support

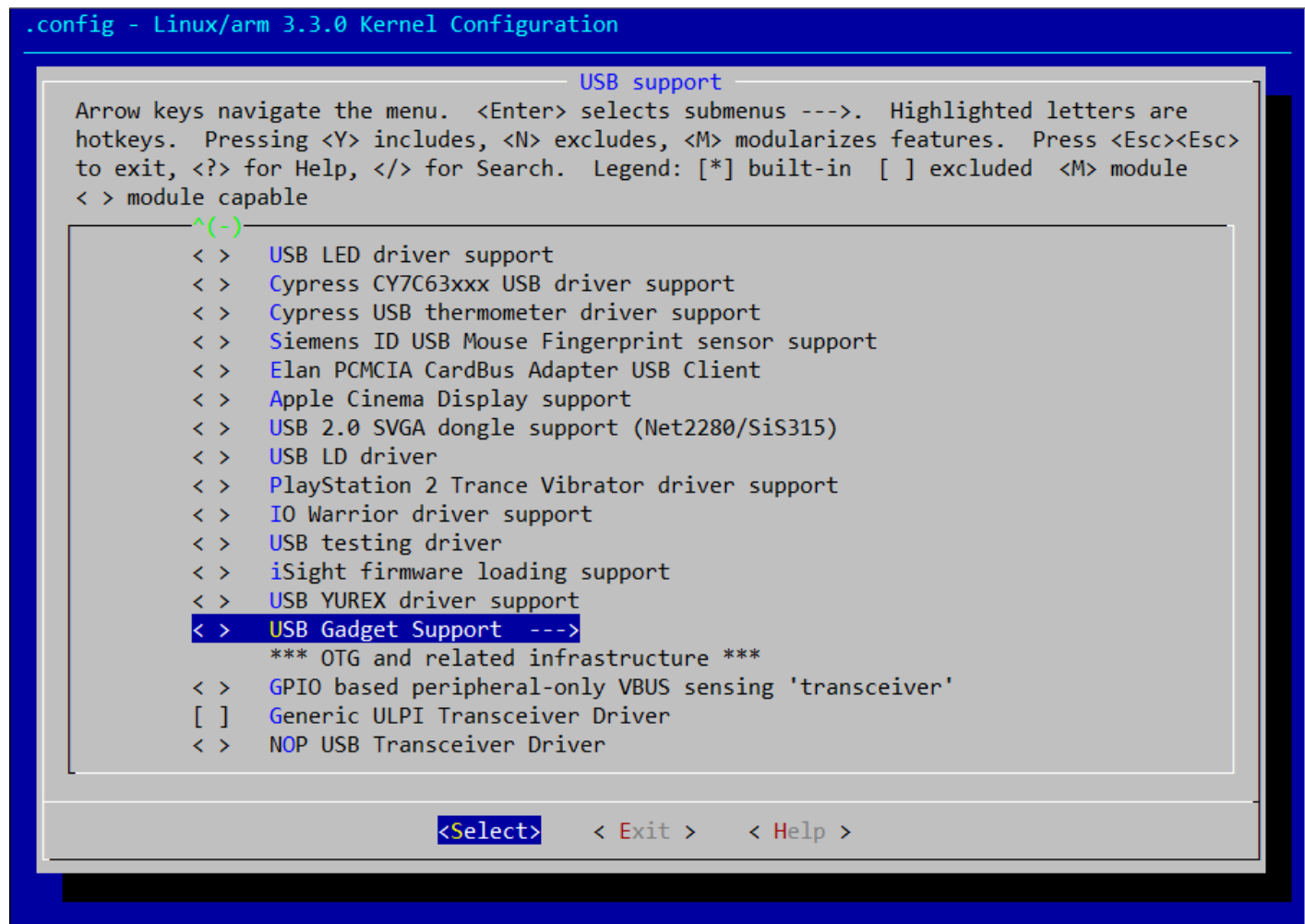


Figure 2-5. FOTG210 Host-only Mode Configuration with Device Function

## 2.3 Class Driver Configuration

To ensure that the USB host will work, users should configure the USB host and the type of the USB device plugged into the system. In this section, different configurations of the USB class are presented, which includes the mass storage.

### 2.3.1 FOTG210 Configuration to Support Mass Storage in Host Mode

This section shows how to configure FOTG210 to support the mass storage class in the host mode.

Choose Y here: Device Drivers → USB support → USB Mass Storage support

```
.config - Linux/arm 3.3.0 Kernel Configuration

                                USB support
Arrow keys navigate the menu. <Enter> selects submenus --->. Highlighted letters are
hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes features. Press <Esc><Esc>
to exit, <?> for Help, </> for Search. Legend: [*] built-in [ ] excluded <M> module
< > module capable

^(-)
< > USB Modem (CDC ACM) support
< > USB Printer support
< > USB Wireless Device Management support
< > USB Test and Measurement Class support
    *** NOTE: USB_STORAGE depends on SCSI but BLK_DEV_SD may ***
    *** also be needed; see USB_STORAGE Help for more info ***
<*> USB Mass Storage support
[ ] USB Mass Storage verbose debug
< > Realtek Card Reader support
< > Datafab Compact Flash Reader support
< > Freecom USB/ATAPI Bridge support
< > ISD-200 USB/ATA Bridge support
< > USBAT/USBAT02-based storage support
< > SanDisk SDDR-09 (and other SmartMedia, including DPCM) support
< > SanDisk SDDR-55 SmartMedia support
< > Lexar Jumpshot Compact Flash Reader
< > Olympus MAUSB-10/Fuji DPC-R1 support
< > Support OneTouch Button on Maxtor Hard Drives
v(+)

<Select> < Exit > < Help >
```

Figure 2-6. FOTG210 Configuration to Support Mass Storage in Host Mode-1

Enable the kernel options of the disk supporting, i.e. pen-drive

Choose Y here: Device Drivers → SCSI device support → SCSI device support

Choose Y here: Device Drivers → SCSI device support → legacy /proc/scsi/ support

Choose Y here: Device Drivers → SCSI device support → SCSI disk support

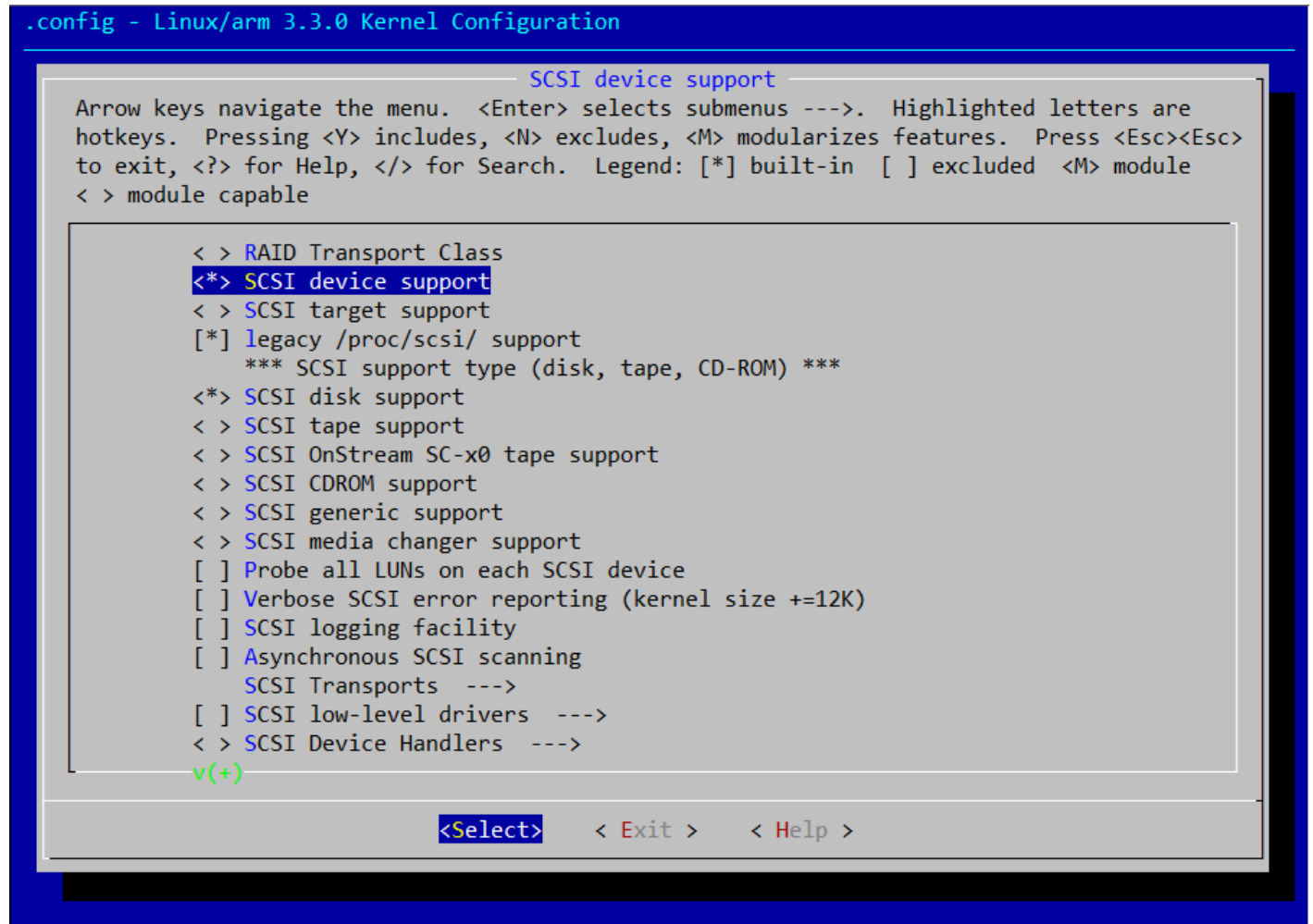


Figure 2-7. FOTG210 Configuration to Support Mass Storage in Host Mode-2



# Chapter 3

## Operation

---

This chapter contains the following sections:

- 3.1 Example of USB Applications
- 3.2 Mass Storage Application in Device Mode
- 3.3 FOTG210 Host-mode Applications
- 3.4 FOTG210 Device-mode Application – Mass Storage
- 3.5 USB Auto-mount/Auto-umount
- 3.6 Reference Files

### 3.1 Example of USB Applications

The USB function in Linux will be instanced for the host applications and gadget applications. The following examples show several USB host/gadget applications:

- USB host pen-drive application: Mount a pen drive as a portable device. This application is used to verify the correctness of the bulk transfers (IN/ OUT) of USB HCD, i.e. asynchronous transfer examination.
- USB gadget of USB file storage: Establish a pen drive to be accessed by a host (PC) as a disk

### 3.2 Mass Storage Application in Device Mode

If FOTG210 is acted as a mass storage device in the device mode, it can be recognized by a pen drive.

When acting as the USB host, please execute the following steps:

1. Configure FOTG210 as "FOTG210 Full-function Configuration"
2. Build the RAM disk by using "dd if=/dev/zero of=ram.img bs=512k count=20" and "/sbin/mkdosfs -F16 ram.img" to create a file system. Once the file system is built, please copy ram.img into RAM disk (Under arm-linux-3.3/target/rootfs-cpio/).

To enable the drivers of other classes that are not described in this document, please refer to the related information from the website.

### 3.3 FOTG210 Host-mode Applications

After booting up Linux, users can see the following message indicating that FOTG210 has booted up. If a pen drive is plugged in FOTG210, users can make the device node and mount it as follows:

"mdev -s" to generate the device node

"mount -t vfat /dev/sda /mnt" if the generated device is sda

Now, users can issue "ls /mnt" to see the content of the pen drive. If users want to remove the pen driver, please use the command, "umount /mnt", first.

Users will see the messages shown below when plugging the USB mass storage into FOTG210. After plugging in the USB mass storage, please enter the "cat /proc/partitions" command to check the partitions that have detected.

```
COM1:38400baud - Tera Term VT
File Edit Setup Control Window Help
/ # usb 1-1: new high speed USB device using FOTG2XX_DRV and address 5
port status 10009
Reset hub_port.....
2nd port status 10009
usb 1-1: configuration #1 chosen from 1 choice
scsi2 : SCSI emulation for USB Mass Storage devices
scsi 2:0:0:0: Direct-Access    SD/MMC   Card Reader    1.00 PQ: 0 ANSI: 0
sd 2:0:0:0: [sda] 1990656 512-byte hardware sectors: (1.01 GB/972 MiB)
sd 2:0:0:0: [sda] Write Protect is off
sd 2:0:0:0: [sda] Assuming drive cache: write through
sd 2:0:0:0: [sda] 1990656 512-byte hardware sectors: (1.01 GB/972 MiB)
sd 2:0:0:0: [sda] Write Protect is off
sd 2:0:0:0: [sda] Assuming drive cache: write through
sda:
sd 2:0:0:0: [sda] Attached SCSI removable disk
sd 2:0:0:0: Attached scsi generic sg0 type 0

/ # mdev -s
/ # mount -t vfat /dev/sda /mnt/usb/
/ # ls /mnt/usb/
evb_rm6243.pdf  linux
/ # cat /proc/partitions
major minor #blocks name
8          0    995328 sda
/ # umount mnt/usb/
/ #
```

### 3.4 FOTG210 Device-mode Application – Mass Storage

After kernel compilation is finished, some modules will be created for the device mode under the path “drivers/usb/gadget”. They are udc-core.ko, g\_GM\_udc.ko, and g\_file\_storage.ko. If users want to act as the device mode, please insert these modules by the following sequence:

```
# insmod udc-core.ko
# insmod g_GM_udc.ko
# insmod g_file_storage.ko
```

The console message is shown as below:

```
/ # insmod udc-core.ko
/ # insmod g_GM_udc.ko
CONFIG_GM_OTG_CHOOSE=0
Init GM UDC ISR finished
/ # OTG_handler: FOTG2XX is now in Mini-B type 0
OTG_handler: do ID change
ID-B OTG Role change... 1b00
enter device mode....
WARNING: Your OTG controller don't know how to act as USB device
        Please enable gadget function

/ # insmod g_file_storage.ko
g_file_storage fotg2xx_udc: File-backed Storage Gadget, version: 1 September 2010
g_file_storage fotg2xx_udc: NOTE: This driver is deprecated. Consider using g_mass_storage instead.
g_file_storage fotg2xx_udc: Number of LUNs=1
g_file_storage fotg2xx_udc-lun0: ro=0, nofua=0, file: /dev/mmcblk0p1
/ # vUsb_suspend : L0, Bus suspend
```

When EVB plugs in PC through a USB cable, a new disk drive will be added on PC and the console message is shown as below:

```
vUsb_rst : L1, Bus reset
vUsb_ep0setup : L2, high speed mode
vUsb_rst : L3, Bus reset
vUsb_ep0setup : L4, high speed mode
enable ep1-bulkin IN maxpacket 512
enable ep2-bulkout OUT maxpacket 512
g_file_storage fotg2xx_udc: high-speed config #1
Error ep_isr ==> ep(1)'s LIST(0x8244b944) is empty
set in stall bit
set in stall bit
Error ep_isr ==> ep(1)'s LIST(0x8244b944) is empty
set in stall bit
Error ep_isr ==> ep(1)'s LIST(0x8244b944) is empty
set in stall bit
Error ep_isr ==> ep(1)'s LIST(0x8244b944) is empty
set in stall bit
Error ep_isr ==> ep(1)'s LIST(0x8244b944) is empty
set in stall bit
set in stall bit
set in stall bit
set in stall bit
```

The default configuration of the mass storage is set to access the SD card, so a SD card must be inserted before loading the module, `g_file_storage.ko`; otherwise, it will be failed on loading module. If users want to change the target that mass storage points to specify the parameter, "file", after module, `g_file_storage.ko`, for example:

```
# insmod g_file_storage.ko file=/ram.img
```

The default setting for the source code of the mass storage points is defined in file, `drivers/usb/gadget/file_storage.c`, specified by the element, "file[0]", in struct `mod_data`.

```
mod_data = {
    // Default values
    .file[0]      = "/dev/mmcblk0p1", //"/ram.img",
    .serial       = "0123456789ABCD",
    .transport_parm = "BBB",
    .protocol_parm  = "SCSI",
    .removable     = 1,
    .can_stall     = 1,
```

```
.cdrom          = 0,  
.vendor         = FSG_VENDOR_ID,  
.product        = FSG_PRODUCT_ID,  
.release        = 0xffff, // Use controller chip type  
.buflen         = 16384,  
};
```

Users can change the role of the platform from the device mode to the host mode by removing the modules of the device driver. Please perform the following sequence:

```
# rmmod g_file_storage  
# rmmod g_GM_udc  
# rmmod udc-core
```

The console message is shown as below:

```
/ # rmmod g_file_storage  
/ # rmmod g_GM_udc  
/ # OTG_handler: FOTG2XX is now in Mini-A type 0  
fotg210 fotg210.0: USB 2.0 started, EHCI 1.00  
ID-A OTG Role change... 300  
enter host mode....  
/ # rmmod udc_core
```

### 3.5 USB Auto-mount/Auto-umount

Users can follow the steps below to use the auto-mount/auto-umount of USB:

1. Open the hot-pluggable function in kernel menu configuration. The path is General setup -> Configure standard kernel features -> Support for hot-pluggable devices. Please refer to the image below.

```
.config - Linux/arm 3.3.0 Kernel Configuration

--- Configure standard kernel features (expert users)
Arrow keys navigate the menu.  <Enter> selects submenus --->.
Highlighted letters are hotkeys.  Pressing <Y> includes, <N> excludes,
<M> modularizes features.  Press <Esc><Esc> to exit, <?> for Help, </>
for Search.  Legend: [*] built-in [ ] excluded <M> module < >

--- Configure standard kernel features (expert users)
[*]   Enable 16-bit UID system calls
[*]   Sysctl syscall support
[*]   Load all symbols for debugging/ksymoops
[*]   Include all symbols in kallsyms
[*Y]  Support for hot-pluggable devices
[*]   Enable support for printk
[*]   BUG() support
[*]   Enable ELF core dumps

<Select>    < Exit >    < Help >
```

2. Add the commands in "arm-linux-3.3/target/rootfs-cpio/etc/init.d/rc.sysinit". Please refer to the image below.

```
1 #!/bin/sh
2
3 PATH=/bin:/sbin:/usr/bin:/usr/sbin
4 export PATH
5
6 # mount root filesystem in read-write mode
7 /bin/busybox echo "Mounting root fs rw ..."
8 /bin/busybox mount -n -o remount,rw /
9
10 if [ ! -e /proc/mounts ]; then
11     /bin/busybox mount -t sysfs sysfs /sys
12     /bin/busybox mount -t proc proc /proc
13 fi
14
15 echo "-----Starting mdev....."
16 /bin/echo /sbin/mdev > /proc/sys/kernel/hotplug
17
18 /bin/busybox mdev -s
19 /bin/busybox --install -s
20
21 # mount all other filesystems
22 /bin/busybox echo "Mounting other filesystems ..."
23 /bin/busybox mount -a
```

3. Create the "arm-linux-3.3/target/rootfs-cpio/etc/mdev.conf" file with the following content.

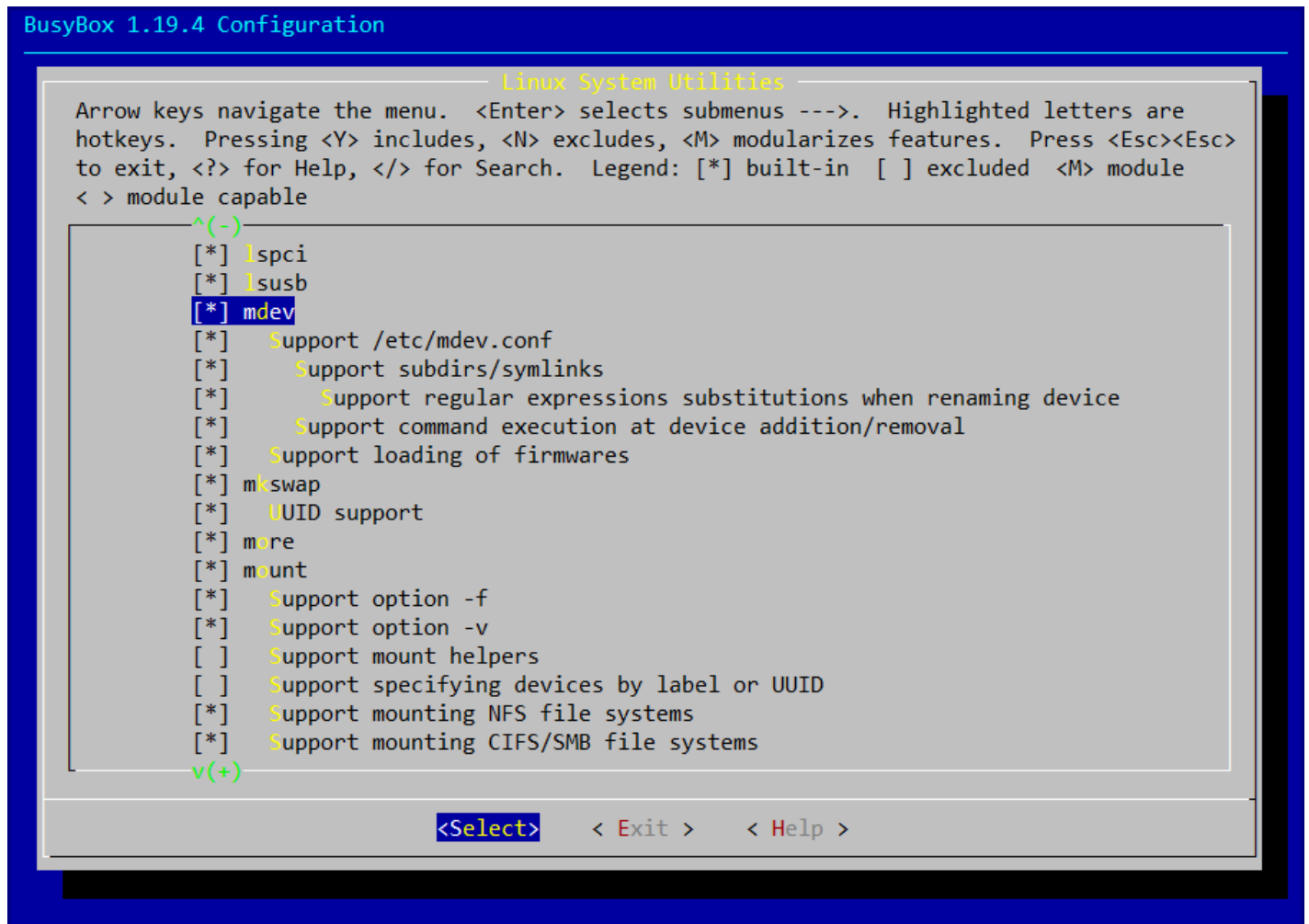
```
1 sd.* 0:0 660 */sbin/automount.sh $MDEV
2 mmc.* 0:0 660 */sbin/automount.sh $MDEV
```



4. Create the "arm-linux-3.3/target/rootfs-cpio/sbin/automount.sh" file with the following content (As an example)

```
1 MOUNT=/bin/mount
2 UMOUNT=/bin/umount
3 MKDIR=/bin/mkdir
4 RMDIR=/bin/rmdir
5 case $1 in
6     "mmcblk0")
7         domount $1
8         ;;
9     "mmcblk0p1")
10        domount $1
11        ;;
12    "sda")
13        domount $1
14        ;;
15    "sdb")
16        domount $1
17        ;;
18    "sdc")
19        domount $1
20        ;;
21    "sdd")
22        domount $1
23        ;;
24    *)
25        exit 1
26        ;;
27 esac
28
29 function domount{
30     M=`mount | grep $1`
31     if [ "$M" = "" ]; then
32         if [ ! -d /mnt/$1 ]; then
33             $MKDIR /mnt/$1
34         fi
35         $MOUNT -t vfat /dev/$1 /mnt/$1
36     else
37         $UMOUNT -lf /mnt/$1
38         $RMDIR /mnt/$1
39     fi
40 }
```

5. Under "arm-linux-3.3/user/busybox-1.19.4" use "make menuconfig" to enable the mdev related functions. The item is in "Linux System Utilities". Please refer to the image below.



6. Use "make" to generate busybox and copy busybox to the path, "arm-linux-3.3/target/rootfs-cpio/bin"
7. Build the Linux image and then users can get USB auto mount/umount feature

### 3.6 Reference Files

- FOTG210 Data Sheet
- Universal Serial Bus Specification, Revision 2.0
- Enhanced Host Controller Interface Specification for USB, Revision 1.0
- Deltef Fliegl, "Programming Guide for Linux USB Device Drivers",  
<http://usb.cs.tum.edu/download/usbdoc/usbdoc-1.32.pdf>
- Brad Hards, "Compliance testing the Linux USB sub-system",  
<http://linux-usb-test.sourceforge.net/docs/interop-0.2/USB-interop.ps>