

Datasheet

BIOSUSB Datasheet

01.10.02

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1 Introduction

The BIOSUSB Package (based on JUNGO USB stack) provides capability to incorporate USB host or USB device functionality on embedded C6747/OMAPL137 and C6748/OMAPL138 platform. This document provides the performance data for USB MSC Host class and MSC-Slave device class drivers on DSP/BIOS™.

2 BIOSUSB Drivers - Features

- Supported Devices
 - C6747/OMAPL137
 - C6748/OMAPL138
- Developed and tested on C6748/OMAPL138 EVM
- USB Host features supported on DSP/BIOS™:
 - MSC class driver
 - HID class driver
- USB –Slave/Device features supported on DSP/BIOS™:
 - Mass storage class
 - HID class
- USB Dual Mode features
 - Switching between Host and Device mode without reloading the stack image on the platform

3 Performance data for BIOSUSB drivers

The performance data for the drivers are captured into following sections

- Features supported/not supported
- I/O throughput and corresponding CPU load are captured for MSC-Host
 - Raw read/write from/to sectors of msc-device connected to
 - USB1 (OHCI controller)
 - USB0 (MUSB controller)
 - File read/write over RTFS file system from/to msc-device connected to
 - USB1 (OHCI controller)
 - USB0 (MUSB controller)
- I/O throughput and corresponding CPU load are captured for MSC-Slave mass storage device. The Mass storage device class supports MMC/SD or NAND device as end storage media.
 - File read/write from/to C6747/OMAPL137 and C6748/OMAPL138 platform as Mass storage device with MMC/SD as storage client connected to windows XP Host.
 - File read/write from/to C6748/OMAPL138 platform as Mass storage device with SATA as storage client connected to windows XP Host .
 - The following storage devices used for testing
 - 4GB-MMC/SD Card
 - Seagate 500GB SATA Hard Disk

3.1 USB driver

This chapter describes the features supported/not supported, constraints and performance numbers. The C6747/OMAPL137 and C6748/OMAPL138 platform support USB1.1 based OHCI controller and USB2.0 MUSB controller.

3.2 OHCI controller

3.2.1 Description

USB Full speed controller. Primarily intended for use in low speed applications such as mouse, keyboard etc. Supports Full and Low speed operation.

3.2.2 Driver Features

The USB Host stack support following class driver

1. Human Interface Class (HID).
2. Mass Storage Class (MSC)
3. Hub Class

3.2.3 Features Not Supported

None.

3.3 MUSB Controller

3.3.1 Description

MUSB controller support's host or device mode of operation. The mode selection is done at compile time. In host mode MUSB controller supports all speeds (High, Full and Low), in device mode supports High and Full speed operation. The USB2.0 MUSB controller has an integrated CPPI4.1 DMA for handling transfers.

3.3.2 USB Driver Features

The USB stack supports the following features

Host Mode

1. Human Interface Class (HID)
2. Mass Storage Class (MSC)
3. Hub Class (embedded host)

Slave Mode

1. Human Interface Class (HID)
2. Mass Storage Class (MSC)

3.3.3 Features Not Supported

None.

3.4 USB Mass Storage Class Host Driver

3.4.1 Description

This implements support for mass storage class peripherals like USB Pen drive, HDD etc.

3.4.2 Driver Features

The driver supports DMA mode transfers.

3.4.3 Features Not Supported

PIO mode is not supported.

3.4.4 Constraint

None

3.4.5 I/O Throughput and CPU Loading (MUSB Host)

The following tables details the performance figures for USB Host configuration.

MUSB Host Controller (USB0)

1. Performance for read/write files (using ERTFS) from/to USB HDD.
2. Performance for read/write sectors from/to USB HDD.

OHCI Host Controller (USB1)

- a. Performance for read/write sectors from/to USB HDD.
- b. Performance for read/write files (using ERTFS) from/to USB HDD.

CPU load and throughput are calculated between start of I/O operation and end of I/O operation at application level. The performance is based on the USBHard Disk Drive (IOMEGA).

3.4.5.1 I/O Performance with various buffer sizes (USB0) for C6747 Platform

The following graphs represent throughput numbers for sector read/write and file read/write at various buffer sizes. The table 1 to 4 details the performance and cpu load at various buffer sizes.

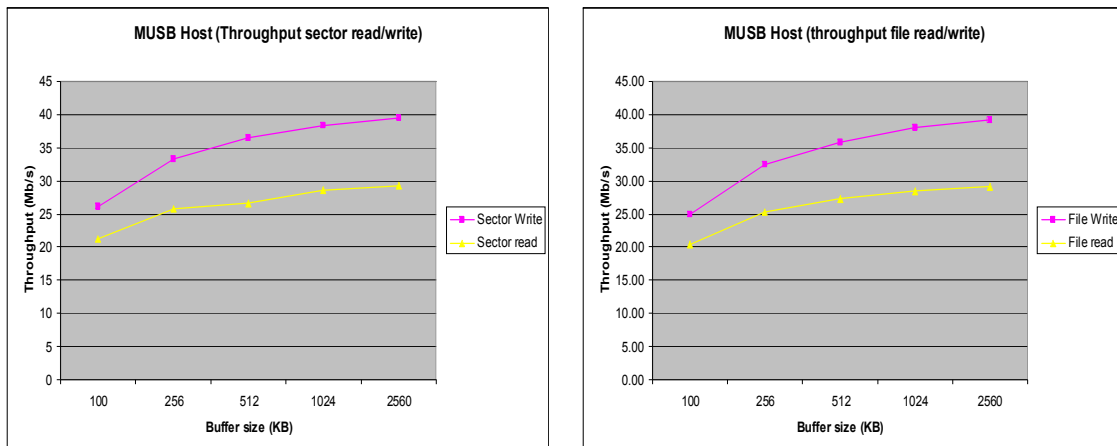


Fig 1. Throughput for sector read/write and file read/write (USB0)

3.4.5.1.1 USB-HOST-MSC sector write Performance (USB0)

Buffer size (Kbytes)	Total Bytes Transferred (MB)	Transfer Rate (MB/s)	Time (ms)	CPU Load in %
100	100	26.08	3926	44
256	100	33.37	3068	24
512	100	36.55	2801	14
1024	100	38.32	2672	9
2560	100	39.54	2590	6

Table 1. USB-HOST-MSC sector write Performance values for C6747 platform

3.4.5.1.2 USB-HOST-MSC sector read Performance (USB0)

Buffer size (Kbytes)	Total Bytes Transferred (MB)	Transfer Rate (MB/s)	Time (ms)	CPU Load in %
100	100	21.20	4829	36
256	100	25.82	3965	20
512	100	26.56	3765	13
1024	100	28.68	3570	9
2560	100	29.34	3490	6.7

Table 2 USB-HOST-MSC sector read Performance values for C6747 platform

3.4.5.1.3 USB-HOST-MSC file write Performance (USB0)

Buffer size (Kbytes)	Total Bytes Transferred (MB)	Transfer Rate (MB/s)	Time (ms)	CPU Load in %
100	100	24.90	4111	45
256	100	32.41	3160	26
512	100	35.84	2857	16
1024	100	37.91	2701	10.2
2560	100	39.20	2612	6.47

Table 3. USB-HOST-MSC file write Performance values for C6747 platform

3.4.5.1.4 USB-HOST-MSC File Read Performance (USB0)

Buffer size (Kbytes)	Total Bytes Transferred (MB)	Transfer Rate (MB/s)	Time (ms)	CPU Load in %
100	100	20.34	5032	38.35
256	100	25.20	4063	21.08
512	100	27.21	3762	13.82
1024	100	28.38	3608	9.7
2560	100	29.09	3519	7.0

Table 4. USB-HOST-MSC File read Performance values for C6747 platform

3.4.5.2 I/O Performance with various buffer sizes (USB1) for C6747 platform

The following graphs represent throughput numbers and CPU loads for sector read/write and file read/write at various buffer sizes. The table 5 to 8 details the performance and cpu load at various buffer sizes.

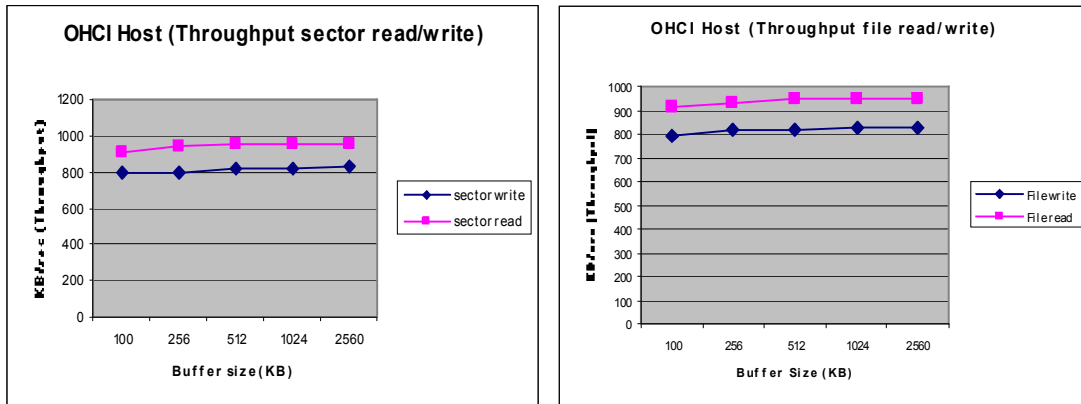


Fig 2. Throughput for sector read/write and file read/write (USB1)

3.4.5.2.1 USB-HOST-MSC sector write Performance (USB1)

Buffer size (Kbytes)	Total Bytes Transferred (MB)	Transfer Rate (KB/s)	Time (ms)	CPU Load in %
100	10	793	13158	29
256	10	817	12826	25
512	10	823	12740	23
1024	10	827	12672	21
2560	10	828	12652	22

Table 5 USB-HOST-MSC sector write Performance values for C6747 platform

3.4.5.2.2 USB-HOST-MSC sector read Performance (USB1)

Buffer size (Kbytes)	Total Bytes Transferred (MB)	Transfer Rate (KB/s)	Time (ms)	CPU Load in %
100	10	908	11494	33
256	10	939	11160	28
512	10	948	11060	24
1024	10	952	11010	23
2560	10	956	10967	25

Table 6. USB-HOST-MSC sector Read Performance values for C6747 platform

3.4.5.2.3 USB-HOST-MSC file write Performance (USB1)

Buffer size (Kbytes)	Total Bytes Transferred (MB)	Transfer Rate (KB/s)	Time (ms)	CPU Load in %
100	100	790	13258	22
256	100	814	12881	15
512	100	820	12781	13.2
1024	100	824	12721	13.2
2560	100	826	12685	12

Table 7. USB-HOST-MSC file write Performance values for C6747 platform

3.4.5.2.4 USB-HOST-MSC file read Performance (USB1)

Buffer size (Kbytes)	Total Bytes Transferred (MB)	Transfer Rate (KB/s)	Time (ms)	CPU Load in %
100	100	909	11526	24
256	100	934	11217	17.3
512	100	944	11090	15.8
1024	100	947	11061	14.5
2560	100	951	11015	14

Table 8. USB-HOST-MSC file read Performance values for C6747 platform

3.4.5.3 I/O Performance with various buffer sizes (USB0) for C6748 Platform

The following graphs represent throughput numbers for sector read/write and file read/write at various buffer sizes. The table 9 to 12 details the performance and cpu load at various buffer sizes.

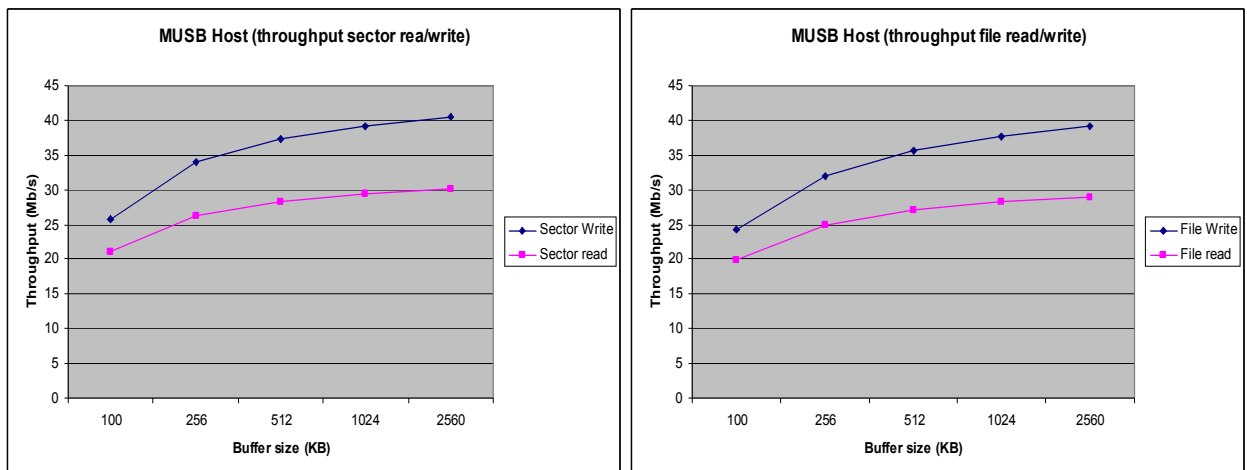


Fig 2. Throughput for sector read/write and file read/write (USB0)

3.4.5.3.1 USB-HOST-MSC sector write Performance (USB0)

Buffer size (Kbytes)	Total Bytes Transferred (MB)	Transfer Rate (MB/s)	Time (ms)	CPU Load in %
100	100	25.72	3981	27
256	100	33.90	3093	24.5
512	100	37.32	2808	14.9
1024	100	39.18	2676	9
2560	100	40.45	2592	6

Table 9. USB-HOST-MSC sector write Performance values for C6748 Platform

3.4.5.3.2 USB-HOST-MSC sector read Performance (USB0)

Buffer size (Kbytes)	Total Bytes Transferred (MB)	Transfer Rate (MB/s)	Time (ms)	CPU Load in %
100	100	21.04	4865	37
256	100	26.34	3935	20
512	100	28.33	3701	13
1024	100	29.40	3566	9.2
2560	100	30.10	3483	6.7

Table 10 USB-HOST-MSC sector read Performance values for C6748 Platform

3.4.5.3.3 USB-HOST-MSC file write Performance (USB0)

Buffer size (Kbytes)	Total Bytes Transferred (MB)	Transfer Rate (MB/s)	Time (ms)	CPU Load in %
100	100	24.23	4225	48.48
256	100	31.87	3213	26.91
512	100	35.56	2879	16.66
1024	100	37.72	2714	10.63
2560	100	39.17	2614	6.68

Table 11. USB-HOST-MSC file write Performance values for C6748 Platform

3.4.5.3.4 USB-HOST-MSC File Read Performance (USB0)

Buffer size (Kbytes)	Total Bytes Transferred (MB)	Transfer Rate (MB/s)	Time (ms)	CPU Load in %
100	100	19.86	5155	39.61
256	100	24.95	4105	21.76
512	100	27.04	3786	14.32
1024	100	28.22	3628	10
2560	100	29.00	3530	7.24

Table 12. USB-HOST-MSC File read Performance values for C6748 Platform

3.4.5.4 I/O Performance with various buffer sizes (USB1) for C6748 Platform

The following graphs represent throughput numbers and CPU loads for sector read/write and file read/write at various buffer sizes. The table 13 to 16 details the performance and cpu load at various buffer sizes.

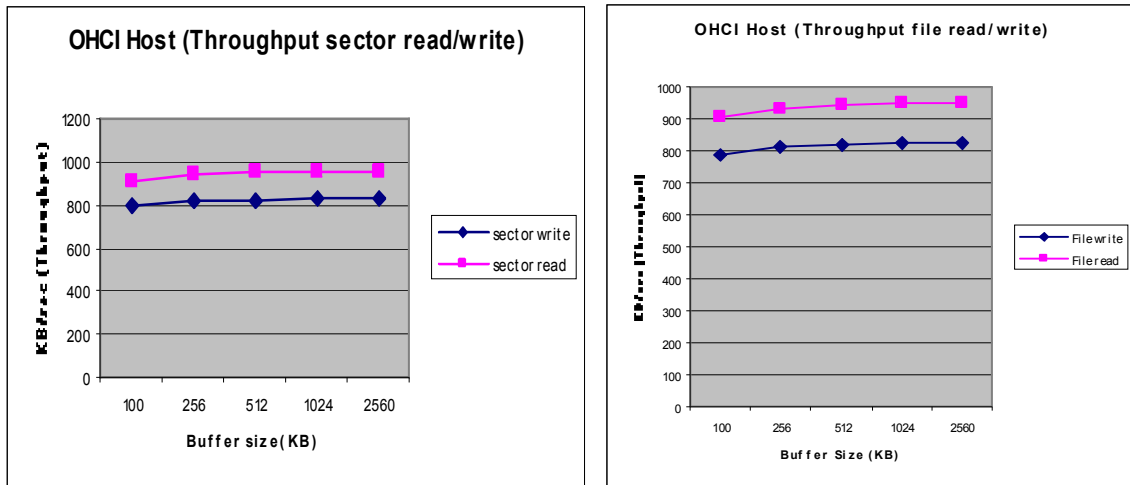


Fig 3. Throughput for sector read/write and file read/write (USB1)

3.4.5.4.1 USB-HOST-MSC sector write Performance (USB1)

Buffer size (Kbytes)	Total Bytes Transferred (MB)	Transfer Rate (KB/s)	Time (ms)	CPU Load in %
100	10	793	13158	30
256	10	818	12810	26
512	10	823	12740	23
1024	10	826	12690	23
2560	10	828	12652	23

Table 13 USB-HOST-MSC sector write Performance values for C6748 Platform

3.4.5.4.2 USB-HOST-MSC sector read Performance (USB1)

Buffer size (Kbytes)	Total Bytes Transferred (MB)	Transfer Rate (KB/s)	Time (ms)	CPU Load in %
100	10	906	11525	34
256	10	939	11161	30
512	10	948	11060	29
1024	10	952	11010	27
2560	10	955	10972	28

Table 14. USB-HOST-MSC sector Read Performance values for C6748 Platform

3.4.5.4.3 USB-HOST-MSC file write Performance (USB1)

Buffer size (Kbytes)	Total Bytes Transferred (MB)	Transfer Rate (KB/s)	Time (ms)	CPU Load in %
100	100	790	13258	21
256	100	814	12881	15
512	100	820	12781	13.7
1024	100	824	12721	12
2560	100	826	12685	12

Table 15. USB-HOST-MSC file write Performance values for C6748 Platform

3.4.5.4.4 USB-HOST-MSC file read Performance (USB1)

Buffer size (Kbytes)	Total Bytes Transferred (MB)	Transfer Rate (KB/s)	Time (ms)	CPU Load in %
100	100	909	11525	24
256	100	934	11217	17
512	100	945	11096	15
1024	100	948	11059	14
2560	100	951	11017	14

Table 16. USB-HOST-MSC file read Performance values for C6748 Platform

3.5 USB Mass Storage Class Function Driver

3.5.1 Description

This section details USB device features and MSC-slave device performance and CPU Load.

3.5.2 Driver Features

The driver supports the following features

1. DMA mode
2. SD/NAND media as the storage medium

3.5.3 Features Not Supported

None

3.5.4 Constraint

None

3.5.5 File I/O Performance for USB MSC-Slave with Storage Clients as MMCSD/SATA/RamDisk
3.5.5.1 USB Slave-MSC-Device File Write Performance From windows XP Host for C6748 Platform ((MMC/SD 4GB)

Total Bytes Transferred (MB)	Transfer Rate (MB/s)	Time (sec)	CPU Load in %
512	5.56	92	35

Table 17 USB Slave-MSC device File write Performance values for MMC/SD

3.5.5.2 USB Slave-MSC-Device File Read Performance From windows XP Host for C6748 Platform (MMC/SD 4GB)

Total Bytes Transferred (MB)	Transfer Rate (MB/s)	Time (sec)	CPU Load in %
512	8.39	61	20

Table 18. USB Slave-MSC device File read Performance values for MMC/SD

3.5.5.3 USB Slave-MSC-Device File Write Performance From windows XP Host for C6748 Platform (SATA)

Total Bytes Transferred (MB)	Transfer Rate (MB/s)	Time (sec)	CPU Load in %
512	11.9	43	64

Table 19 USB Slave-MSC device File write Performance values for SATA

3.5.5.4 USB Slave-MSC-Device File Read Performance From windows XP Host for C6748 platform (SATA)

Total Bytes Transferred (MB)	Transfer Rate (MB/s)	Time (sec)	CPU Load in %
512	20.48	25	37

Table 20. USB Slave-MSC device File read Performance values for SATA

3.5.5.5 USB Slave-MSC-Device File Write Performance From windows XP Host for C6747 Platform ((MMC/SD 4GB)

Total Bytes Transferred (MB)	Transfer Rate (MB/s)	Time (sec)	CPU Load in %
512	5.27	97	34

Table 21 USB Slave-MSC device File write Performance values for MMC/SD

3.5.5.6 USB Slave-MSC-Device File Read Performance From windows XP Host for C6747 Platform (MMC/SD 4GB)

Total Bytes Transferred (MB)	Transfer Rate (MB/s)	Time (sec)	CPU Load in %
512	7.53	68	23

Table 22. USB Slave-MSC device File read Performance values for MMC/SD

3.5.5.7 USB Slave-MSC-Device File Write Performance From windows XP Host ((Ram Disk 34MB)

Total Bytes Transferred (MB)	Transfer Rate (MB/s)	Time (sec)	CPU Load in %
35	16.66	2.1	29

Table 23 USB Slave-MSC device File write Performance values for C6747

3.5.5.8 USB Slave-MSC-Device File Read Performance From windows XP Host (Ramdisk 34MB)

Total Bytes Transferred (MB)	Transfer Rate (MB/s)	Time (sec)	CPU Load in %
35	20.2	1.73	20

Table 24. USB Slave-MSC device File read Performance values for C6747

3.5.5.9 USB Slave-MSC-Device File Write Performance From windows XP Host ((Ram Disk 35MB)

Total Bytes Transferred (MB)	Transfer Rate (MB/s)	Time (sec)	CPU Load in %
35	17.5	2	45

Table 24 USB Slave-MSC device File write Performance values for C6748

3.5.5.10 USB Slave-MSC-Device File Read Performance From windows XP Host (Ramdisk 35MB)

Total Bytes Transferred (MB)	Transfer Rate (MB/s)	Time (sec)	CPU Load in %
35	24.1	1.45	40

Table 25. USB Slave-MSC device File read Performance values for C6748

3.6 Memory Foot Print for Device libraries

Memory usage for device libraries

Component	Memory Statistics (Bytes)			
	Program Memory	Data Memory		Total
		Initialized	Un-Initialized	
ti.biosusb.device.dcd.a674	13632	182	116	13930
ti.biosusb.device.core.a674	16832	262	92	17186
ti.biosusb.device.jos.a674	13760	704	310	14774
ti.biosusb.device.port.a674	10656	414	4984	16054
ti.biosusb.device.portcom.a674	8864	592	12	9468
ti.biosusb.device.fd.hid.a674	4064	60	0	4124
ti.biosusb.device.fd.scsi.a674	13408	2046	1820	17274
Total	81216	4260	7334	92810

3.7 Memory Foot Print for Host libraries

Memory usage for host libraries

Component	Memory Statistics (Bytes)			
	Program Memory	Data Memory		Total
		Initialized	Un-Initialized	
ti.biosusb.host.core.a674	89504	3769	3032	96305
ti.biosusb.host.jos.a674	13312	728	333	14373
ti.biosusb.host.port.a674	10496	526	5048	16070
ti.biosusb.host.portcom.a674	8896	620	500032	509548
ti.biosusb.host.hid.a674	13024	221	44	13289
ti.biosusb.host.mass.a674	25760	1486	1844	29090
Total	160992	7350	510333	678675

3.8 Memory Foot Print for Dual mode stack libraries

Memory usage for dual mode stack libraries

Component	Memory Statistics (Bytes)			
	Program Memory	Data Memory		Total
		Initialized	Un-Initialized	
ti.biosusb.dual.jos.a674	14208	728	334	15270
ti.biosusb.dual.port.a674	12256	526	5048	17830
ti.biosusb.dual.portcom.a674	8896	762	500116	509774
Total	35360	2016	505498	542874

Revision History

Date	Author	Revision History	Version
May 2009	Ravi Babu	Support of C6747 platform on CCS3	01_00_00_04
Nov 2009	Ravi Babu	Support for C6747/C6748 platform on both CCS3/CCS4	01_10_01_01
Feb 2010	Sundaram Raju	Support dual mode feature with additional fixes	01_10_02_01
