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MCCI USB DataPump Footprint Information

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1 Introduction

1.1 Purpose

This document presents the code and memory footprint statistics for the MCCI USB DataPump® OTG Stack.

1.2 Scope

The document contains the code size for all DataPump components. It also provides the details of the code size and RAM size requirements with various configuration values. Here's the information about the software and hardware to measure these footprints.

- CVS Tag: USBKERN-V3_10-20120724a
- Compiler: GCC, RealView
- Reference platform: IPMATE with Synopsys DWC HS controller V2.93a

1.3 Glossary

Table 1. Glossary

Name	Description
DCD	The software component that provides low-level access to the specific Device Controller in use
HCD	The software component that provides low–level access to the specific Host Controller in use
OTG	The software component that provides low-level access to a USB bus via an OTG Controller. Normally export three APIs, an HCD API, a DCD API, and a (shared) OTG
PHY	Short for "physical layer". Often used as short-hand for "transceiver". MCCI uses this in the abbreviations for the API operations that are used for accessing the phy
MSC	Mass Storage Class
WMC	Wireless Mobile Communications
ACM	Abstract Control Model for handling AT-command modems.
VSP	Virtual Serial Protocol
HID	Human Interface Device

Name	Description
NCM	Network Control Model
CDC ECM	Communication Device Class – Ethernet Control Model
USBD	USB Driver, the generic term for the USB Management module
TT	A functional component of a USB hub. The Transaction Translator responds to special high-speed transactions and translates them to full/low-speed transactions with full/low-speed devices attached down downstream facing ports.

1.4 Referenced Documents

Table 2. Referenced Documents

MCCI DataPump Dynamic Sizing, *Engineering Report 950000519*
MCCI DataPump Embedded Host Mass Storage Class Driver, *Engineering Report 950000332*
MCCI DataPump Embedded Host Basic HID Class Driver, *Engineering Report 950000328*
MCCI DataPump Transaction Translator, *Engineering Report 950000548*
MCCI Composite Device Users Guide, *Engineering Report 950000684*
MCCI DataPump Embedded Host and OTG Users Guide, *Engineering Report 950000327*

2 DataPump Code Size

The code size for the MCCI USB DataPump Device/Host/OTG stack is shown in Table 3. The DataPump is compiled with GCC and the output is generated from arm-elf-size tool. The actual code size linked in the library would be smaller than these values. The details for calculating DataPump code size and dynamic memory size for a customer specific platform are described in the next section.

How to generate the code size for all DataPump components:

- makebuildtree –b free –c gcc wombat
- change directory to the build directory
- bsdmake
- run usbkern/bin/all-chip-compile.sh
- run usbkern/bin/datapump-size.sh

Table 3. DataPump Code Size

Module	Test	Data	Bss
common	101966	0	2
proto/abstractnic	50368	0	8
proto/adb	2584	0	0
proto/atcmd	9360	0	0
proto/audio	7816	0	0
proto/audio2	8716	0	0
proto/cam	4984	0	0
proto/cdcether	10400	0	0
proto/dfu	8054	0	0
proto/encm	23430	0	0
proto/hid	4700	0	0
proto/loopback	3024	0	0
proto/mbim	20772	0	0
proto/mcpc	13596	0	0
proto/mcpc/applib	5356	0	176
proto/msc	28744	0	2097184 (2MB RAM disk)
proto/msc/applib	2984		
proto/msic	13958	0	0
proto/ndfu	9766	4	4
proto/ndfu/applib	1940	0	4
proto/proxy	8410	0	0
proto/rndis	9892	0	0
proto/uasp	28403	0	2097180 (2MB RAM disk)

Module	Test	Data	Bss
proto/vether	6006	0	0
proto/video	9968	0	0
proto/vsp2	11732	0	0
proto/wmc	10748	0	0
proto/wmc/applib	11828	0	0
host/common	2804	0	0
host/hcdkit	11570	0	0
host/usbd	92594	0	0
host/option	23772	0	0
host/classkit	5892	0	0
host/class/abstractnic	53464	0	0
host/class/cbaf	3588	0	0
host/class/composite	13196	0	0
host/class/generic	9972	0	0
host/class/hid	13188	0	0
host/class/msc	21488	0	0
phy/common	3244	0	0
ifc/ad6900	22052	0	0
ifc/adi	21984	0	0
ifc/al5600	28125	1638	8604
ifc/bcm3310	14268	0	0
ifc/cl2162	17088	0	26
ifc/d12	10326	0	0
ifc/dwc3884sp	36452	0	0
ifc/dwchsotg	82108	0	0
ifc/dwcusb3	15184	0	0

Module	Test	Data	Bss
ifc/ehci	22910	0	80
ifc/inventra	59874	0	0
ifc/ip9028	17316	0	0
ifc/isp1362	15800	0	0
ifc/isp1582	20944	0	0
ifc/isp1761	30052	0	0
ifc/isp3582	20786	96	4208
ifc/mc9328mx21	15980	0	0
ifc/mc9328mxl	12080	0	0
ifc/mirage	10848	0	0
ifc/mpc850	10820	0	0
ifc/omap5912	12748	0	0
ifc/pcf5213	23148	1	0
ifc/pic18f4550	15196	0	0
ifc/pnx5220	29748	0	0
ifc/plx3382	27188	0	0
ifc/pnx8009	12596	0	0
ifc/proxy	540	0	0
ifc/ptfnx	22400	0	0
ifc/r8a66597	38224	0	0
ifc/s1r72005	27333	0	0
ifc/s5p6x	55184	0	0
ifc/sa1110	12836	4	16
ifc/sk8850	12168	0	0
ifc/uss820	24924	0	25
ifc/visionx100	22960	0	0

Module	Test	Data	Bss
ifc/xdci	27056	0	0
ifc/xhcd	54044	8	0

3 Calculating DataPump Code Size and Memory Size Requirements

The actual code size (.text) and the dynamic memory size depend on the components included in the device or host stack. The DataPump device stack consists of the low-level DCD, common device function, and device protocol drivers. The DataPump host stack consists of the low-level HCD, common host function, and host class drivers. OS-specific code and application specific code are excluded in this section.

3.1 Test Environment

3.1.1 Platform Information

- Platform Environment: ARM9, os/none, Synopsys DWC HS OTG Core V2.93a
- Compiler: RealView

3.1.2 Getting Code Size

The actual code size (.text) would be extracted from the generated map files after building DataPump applications.

To generate the code size in the Arm mode

- checkout client/milkweed/ipmate
- makebuildtree –b free –c relaview ipmate
- change directory to the build directory
- bsdmake
- open .map file for each DataPump application.

To generate the code size in the Thumb mode:

- open usbkern/arch/arm7/port/ipmate/mk/buildset.var and add
  CPU_ARCH = thumb
- makebuildtree –b free –c relaview ipmate
- bsdmake clean
- bsdmake

- open .map file for each DataPump application

3.1.3 Getting Dynamic Memory Size

The memory requirements for the DCD depends on the endpoints configuration, and DMA mode. The descriptor based DMA needs more memory than the buffered DMA. DCD allocates additional memory for the DMA descriptor per endpoint to support the Scatter Gather DMA. The buffered DMA mode is used to calculate the memory size in Table 5.

- DMA mode: Buffered DMA
- Total number of endpoints used in the DataPump application
- Local buffer size per endpoint:
  DCD allocates a local buffer for each endpoint to copy data when the data buffer is not aligned for the DMA operation in the core. It is aligned buffer to hold at least one maximum packet size for an endpoint. Typically 64 bytes for Control endpoint, 512 bytes for Bulk endpoint.

The memory requirements for the HCD depends on the number of host channels and the DMA mode. The descriptor based DMA needs more memory than the buffered DMA. HCD allocates additional memory for the DMA descriptor per host channel to support the Scatter Gather DMA.

HCD configurations for DWC HS host controller:

- DMA mode: Buffered DMA.
- Totoal number of host channels: 1 host channel
- Local buffer size for each host channel: 1K bytes

To generate RAM size:

- Run each DataPump application
- Check the debug output and look for the memory size for each object.

```
<Alloc><obj> default.platform.mcci.com#0 </obj>t<n> 0x000200 </n></Alloc>
<Alloc><miscellaneous> InterruptSystem  </miscellaneous>t<n> 0x001040 </n></Alloc>
<Alloc><miscellaneous> TimerSystem      </miscellaneous>t<n> 0x000228 </n></Alloc>
<Alloc><obj> UDEVICE_MSCDEMO.dwchsotg.device.mcci.com#0 </obj>t<n> 0x000e90
</n></Alloc>
<Alloc><obj> storage.atapi.bot.msc.fn.mcci.com#0 </obj>t<n> 0x000718 </n></Alloc>
```

3.2 Device Stack Example – MSC Demo Application

Estimate the code size and memory size for DataPump V3.10 device stack with MSC protocol.

Table 4. Code Size Estimation – mscdemo application

DataPump Application	Library Name	Arm Mode (Size in Bytes)	Thumb Mode (Size in Bytes)
mscdemo	dwchsotg.a (DCD)	23296	16716
	datapump.a (DataPump common)	38004	23802
	protomsc.a (MSC protocol)	17600	11714
	apistorage.a (MSC protocol)	488	364
	Total	79388	52596

Table 5. Memory Size Estimation – mscdemo application

DataPump Application	Object	Size in Bytes
mscdemo	mscdemo.device (DCD)	3728
	msc.proto (MSC protocol)	1816
	Total	5544

3.3 Host Stack Example – HID/MSC Demo Application

Estimate the code size and memory size for DataPump V3.10 host stack with MSC and HID class drivers.

Table 6. Code Size Estimation – hosthidmscapp application

DataPump Application	Library Name	Arm Mode (Size in Bytes)	Thumb Mode (Size in Bytes)
hosthidmscapp	dwchsotg.a (HCD)	42528	29606
	datapump.a (DataPump common)	42024	27278
	usbd.a	72976	50532

DataPump Application	Library Name	Arm Mode (Size in Bytes)	Thumb Mode (Size in Bytes)
	usbphy.a	2256	1514
	hcd.a	1996	1218
	hcdkit.a	9068	5638
	classmsc.a	17580	12156
	classhid.a	12172	8110
	classcomposite.a	11220	7552
	transaction_translator.a	100	4814
	Total	211920	148418

Table 7. Memory Size Estimation – hosthidmscapp application

DataPump Application	Object	Size in Bytes
hosthidmscapp	dwchsotg.usbphy	600
	dwchsotg.hcd	6464
	roothub.driver	1440
	genhub.driver	1344
	minimal.usbd	11376
	composite.driver	4192
	hid.driver	6176
	msc.driver	4128
	Total	35720

The configuration data used to calculate the RAM size for the host stack are listed in Table 8. The detailed information about calculating the memory requirement of each component using the configuration data can be found at the documents listed in Table 2.

Table 8. Configuration Data For Measuring RAM size - Host

Module	Configuration Values
USBD	bNumberHubs: 1 bPortsPerHub: 4 AnnunciatorMaxSession: 1
Composite Driver	NumInstances: 1 NumberCFs: 2 NumberCSFs: 1 NumberPipes: 2 SizeConfigDesc: 64
HID Class Driver	NumInstances: 1
MSC Class Driver	NumInstances: 1
HCD	Number of host channels: 1