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| Document information | |
| Info | Content |
| Keywords | USBD library source code, LPC, USB stack. |
| Abstract | This technical note describes the history of USBD ROM device driver stack, the differences between LPC4300/LPC1800 series and the rest of the MCUs with USB controller, releases the latest USBD library source with bug fixes and new features. The latest USBD library supports most of the LPC family MCUs including LPC1100 series, LPC1500 series, LPC4300/LPC1800 series, and LPC54000 series. This package works with LPC4300 and LPC1800 series only. |

| Revision history | | |
| --- | --- | --- |
| Rev | Date | Description |
| 1.0 | - | Initial version. |

# Introduction

ROM-based USBD driver has been provided as part of the boot ROM since LPC4300 and LPC1800 series MCUs and widely adopted by many users.

The ROM contains flexible USB device stack to simplify the USB application development. The USBD ROM stack has built-in support for Communication Device Class (CDC), the Human Interface Device (HID), the Mass Storage Class (MSC), Device Firmware Upgrade (DFU) class, etc. It also supports composite device model consisting of multiple interfaces of above supported classes.

However, there are limitations in the earlier version of the USBD driver and some known issues identified by both NXP and end users over time. Since NXP cannot provide instant ROM update for every USBD driver issue found, we have offered work-arounds where possible and described in the errata documentation already. On the other hand, H/W features such as Link Power Management (LPM) were not supported in the earlier version of the USBD ROM, therefore no work-around.

The ROM based USBD driver simplifies the USB application development, however, it makes debugging complex USB class driver more difficult. In addition, some USBD ROM work-arounds require more RAM resources.

On MCUs with larger flash memory size, linking the USBD library components directly will speed up development and make debugging easier. All these work-arounds can be removed as the results.

Therefore, NXP publish two versions of the USBD driver stack source code: residing in the MCU ROM as references and the updated version, also referred as USBD library, with bug fixes on all the known issues and adding new features.

Some of the key new features of the USBD library include:

* Link Power Management (LPM) Support (not apply to LPC4300 and LPC1800 MCUs)
* MSC class enhancement allowing accessing larger memory media greater than 4GB.
* Device Core stack update including Root 2 test (Microsoft XBOX compliance) support
* Enhancement to DFU class to support multiple alternate interfaces
* String descriptor callback. New stack has callback to provide customer string descriptors not present in descriptor array for random indexed strings

We publish two packages of the USBD libraries, although the stack level of the device driver shares the same source code, the low-level drivers for LPC4300/LPC1800 series and LPC1100/LPC1500 series are totally different because these MCUs use different USB device controllers internally. Below table highlights the differences among LPC family MCUs.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| MCUs\Feature | Speed | Max. # of EPs | Link Power Management (LPM) | USB IP |
| LPC1100/LPC1500 series | FS only | 5 | Yes | IP351x |
| LPC4300/LPC1800 series | HS which can be forced to FS in the device driver | 6 | No | IP9028 |
| LPC54100 series | FS only | 5 | Yes | IP351x |
| LPC54600 series | Both HS (port 1) and FS (port 0). The HS controller can’t be forced to FS in the device driver | HS: 6,  FS: 5 | Yes | IP351x |

This following section gives an overview of the USBD library and how to use USBD library to build your USB application for LPC4300/LPC1800 series MCUs.

# Description

At early stage of the USB controller integration, Keil, an ARM company now, and NXP have worked together towards the solution of the USB driver software support, since then, NXP has added more low-level drivers to support different USB IPs, many new features such as Link Power Management (LPM) support, added more USB class driver support such as DFU class, improved memory management and include callbacks make the USBD stack more user friendly, fixed many bugs, etc.

Here is the original Copyright statement of USB driver examples from Keil:

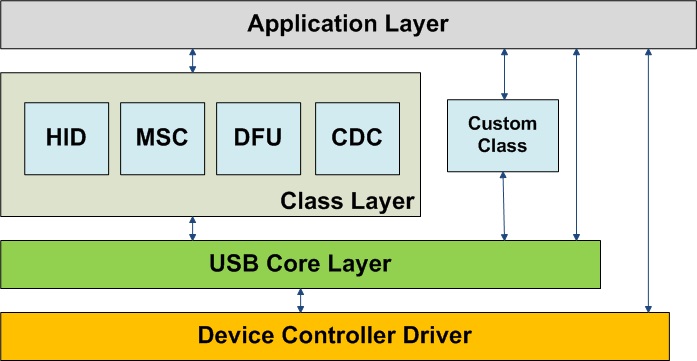
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NXP Semiconductors recognize the original USB driver software work from Keil. This USBD library software is supplied "AS IS" without any warranties. For details of the copyright disclaimer, please refer to header of the included source files.

The following figure shows the architectural block diagram of the USBD device ROM stack. The stack consists of three main layers:

1. The Class Layer
2. The USB Core Layer
3. The Device Controller Driver Layer



The source files of the updated USBD library have been built and tested on Keil, IAR, and MCUXpresso IDEs using LPCXpresso Development Board.

The User Manual of LPCXpresso Development Board for LPC4300 MCUs can be found:

<https://www.nxp.com/support/developer-resources/hardware-development-tools/lpcxpresso-boards/lpcxpresso4367-development-board:OM13088>

The attached USBD library package is based on LPCOpen (version 3) for LPC4300:

<https://www.nxp.com/products/processors-and-microcontrollers/arm-based-processors-and-mcus/lpc-cortex-m-mcus/lpc4300-cortex-m4-m0/lpcopen-software-development-platform-lpc43xx:LPCOPEN-SOFTWARE-FOR-LPC43XX?fsrch=1&sr=3&pageNum=1>

“usbd\_rom\_lpc43xx” directory contains the source of original USBD stack residing in the ROM. **Since it’s unmodified from the LPC43xx/LPC18xx ROM, it contains all the known issues of the USBD ROM device driver stack listed in the LPC43xx/LPC18xx Errata and should be used as references only.**

Note: For the ROM release, the source files of the USBD ROM driver were built on the Keil MDK only. Some of the directives and keywords in the source are for Keil compiler only and may not work on other compilers.

“usbd\_lib\_lpc43xx” directory contains the latest USBD stack library and have fixed all the known issues from USBD ROM. It also contains the LPCOpen.USB class examples using USBD library API calls.

Under “usbd\_lib\_lpc43xx” directory, “LPC\_USBD\_Lib” contains the latest USBD stack library and the rest are the USB class examples making use of USBD library. Identical LPCOpen (version 3) directory structure is applied to these USB class examples.

The USB examples are available in three tool chains:

* IAR embedded Workbench
* Keil MDK
* MCUXpresso

The USBD library can be found under:

**\usbd\_lib\_lpc43xx\prj\_lpc\_usbd\_lib**

The USB class examples can be found under:

**\usbd\_lib\_lpc43xx\prj\_xpresso4337**

The USBD library documentation (revision 2.0) in HTML format is under:

**\usbd\_lib\_lpc43xx\LPC\_USBD\_Lib\docs\html**

Click **\usbd\_lib\_lpc43xx\LPC\_USBD\_Lib\docs\html\index.html** to start.

If using Internet Explorer, click “Allow block Content” to allow page to run script and active X control.

It’s important to note that there are differences between the library documentation and the Section “USB ROM API” of the User’s Manual. The key difference is related to USBD\_API\_INIT\_PARAM data structure defined in “chip\_43xx\_l8xx\usbd\_lib” directory where all the new features have been added.

Under ”\LPC\_USBD\_Lib\mw\_usbd” directory, mw\_usbd\_rom.c has the version identifier of the latest USBD library stack.

Following the “LPCOpen Quick Start Guide for all platforms”, build chip and board libraries first under “lib\_chip\_lpcxxx” and “lib\_board\_lpcxxx”, then, build USBD library under “LPC\_USBD\_Lib”, finally, build your USB class application under “prj\_xpresso4337” directory.

Now, your USB class application links the USBD library APIs instead of the USBD ROM APIs and is ready to run.

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