

# TN00020

## LPC11U6x Crystal-less USB Solution

Rev. 1.2 — 23 February 2018

Technical Note

### Document information

| Info            | Content  |
|-----------------|--|
| <b>Keywords</b> | LPC11U6x, Crystal, full-speed USB, IRC   |
| <b>Abstract</b> | This technical note explains the usage of a software library to provide a full-speed USB crystal-less solution on the LPC11U6x family. |



## Revision history

| Rev | Date     | Description   |
|-----|----------|---|
| 1.2 | 20180223 | <ul style="list-style-type: none"><li>Updated <a href="#">Section 2.3 “Source code modifications”</a>.</li></ul>  |
| 1.1 | 20171115 | <ul style="list-style-type: none"><li>Updated <a href="#">Section 1 “Introduction”</a>: added LPCOpen v.3.01 software example (usbd_rom_hid_generic).</li></ul> |
| 1.0 | 20170804 | Initial version   |

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## 1. Introduction

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The LPC11U6x are an ARM Cortex-M0+ based, low-cost 32-bit MCU family operating at CPU frequencies of up to 50 MHz. The LPC11U6x support up to 256 KB of flash memory, 4 KB of EEPROM, and 36 KB of SRAM.

The LPC11U6x product family features one full-speed USB 2.0 device controller with crystal-less low-speed mode.

To achieve crystal-less USB device operation in full-speed mode, NXP provides a software library solution that measures the Start of Frame (SOF) timing to meet full-speed operation ( $\pm 0.25$  % data rate accuracy).

This technical note explains the steps to modify the software to integrate a crystal-less USB device operation in full-speed mode in the LPC11U6x application. In addition to this technical note, an LPCOpen v.3.01 software example (usbd\_rom\_hid\_generic) is provided in the MCUXpresso/LPCXpresso, Keil, and IAR IDEs.

## 2. Description

This section describes the steps to implement a crystal-less USB full-speed operation for the LPC11U6x.

### 2.1 Calibration library

The software must include the IRC calibration library to enable appropriate calibration to meet the USB full-speed operations. Pre-compiled libraries for MCUXpresso /LPCXpresso, Keil, and IAR are:

1. Keil IDE: keil\_lib\_irc\_calib.lib
2. IAR IDE: iar\_lib\_irc\_calib.a
3. MCUXpresso/LPCXpresso IDE: - libirc\_calib.a

Include the library in the chip\_11u6x/irc\_calib\_lib folder. See [Figure 1](#).

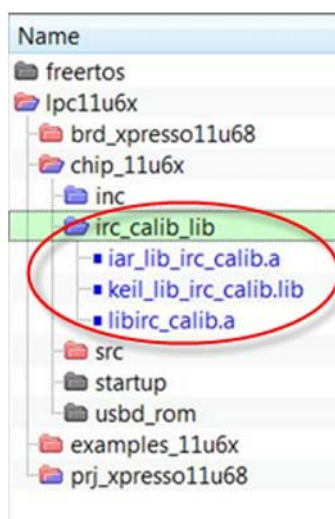


Fig 1. Calibration library

## 2.2 Header file

Include the following header file (irc\_calib\_lib\_11u6x.h) in the chip\_11u6x folder/inc folder. See [Figure 2](#).

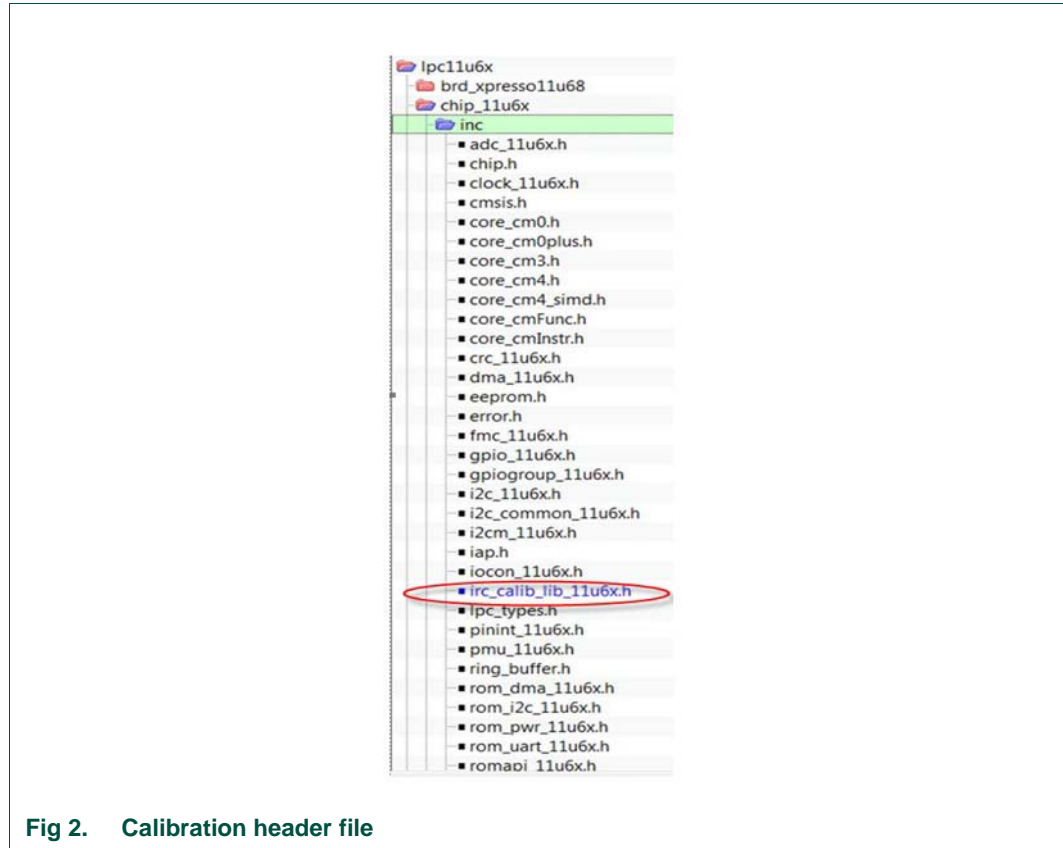


Fig 2. Calibration header file

## 2.3 Source code modifications

Add the following changes to the source code.

1. Call the `int_irc_calib_Get_Lib_Ver` (void) function. This function reads the version of the calibration library and returns 0x00000100. Otherwise, it returns 0x0.
2. In the USBPLLCLKSEL register, the user application code must select the IRC as a clock source for the USB PLL (value of 0x0) because the external crystal is no longer required. See the LPC11U6x/E6x user manual for more details.
3. The calibration library must use one of the 16-bit or 32-bit timers to measure SOF timing and enable appropriate calibration.

- a. Using the SYSAHBCLKCTRL register, enable the clock to the timer used.
- b. Pass the timer peripheral (CT16B0 or CT16B1 or CT32B0 or CT32B1) and the system clock in KHz to the library call:

```
ErrorCode_t Chip_Timer_Instance_Freq (LPC_TIMER_T *pTMR, unsigned int
timerFreq);
```

The library function returns `LPC_OK` if device ID of the LPC11U6x is read, otherwise it returns `ERR_FAILED`.

4. The user application code must enable the `FRAME_INT` of the `INTEN` register.

If using the USB ROM API, the user application code can use the `ErrorCode_t(*USBD_HW_API::EnableEvent)(USBD_HANDLE_T hUsb, uint32_t EPNum, uint32_t event_type, uint32_t enable)` to enable `FRAME_INT`. Ensure the workaround from USB\_ROM.3 errata is implemented. See the LPC11U6x errata sheet for more details.

- When the `FRAME_INT` occurs, the user application code must call the `ErrorCode_t USB_SOF_Event(USBD_HANDLE_T hUsb)`.

If the user application code uses USB ROM API, it can call `ErrorCode_t(*ErrorCodes_t) USBD_HW_API::Init(USBD_HANDLE_T *phUsb, USB_CORE_DESCS_T *pDesc, USB_API_INIT_PARAM_T *param)`

For example:

```
USBD_HANDLE_T g_hUsb;
USBD_API_INIT_PARAM_T usb_param;
USB_CORE_DESCS_T desc;
ErrorCode_t ret = LPC_OK;
usb_param.USB_SOF_Event = USB_SOF_Event;
ret = USBD_API->hw->Init(&g_hUsb, &desc, &usb_param);
```

## 2.4 LPC11U68 LPCXpresso board

The crystal and capacitors can be removed because the external crystal is no longer required. For example, you can remove the following components on the LPC11U68 LPCXpresso V2 board. See [Figure 3](#).

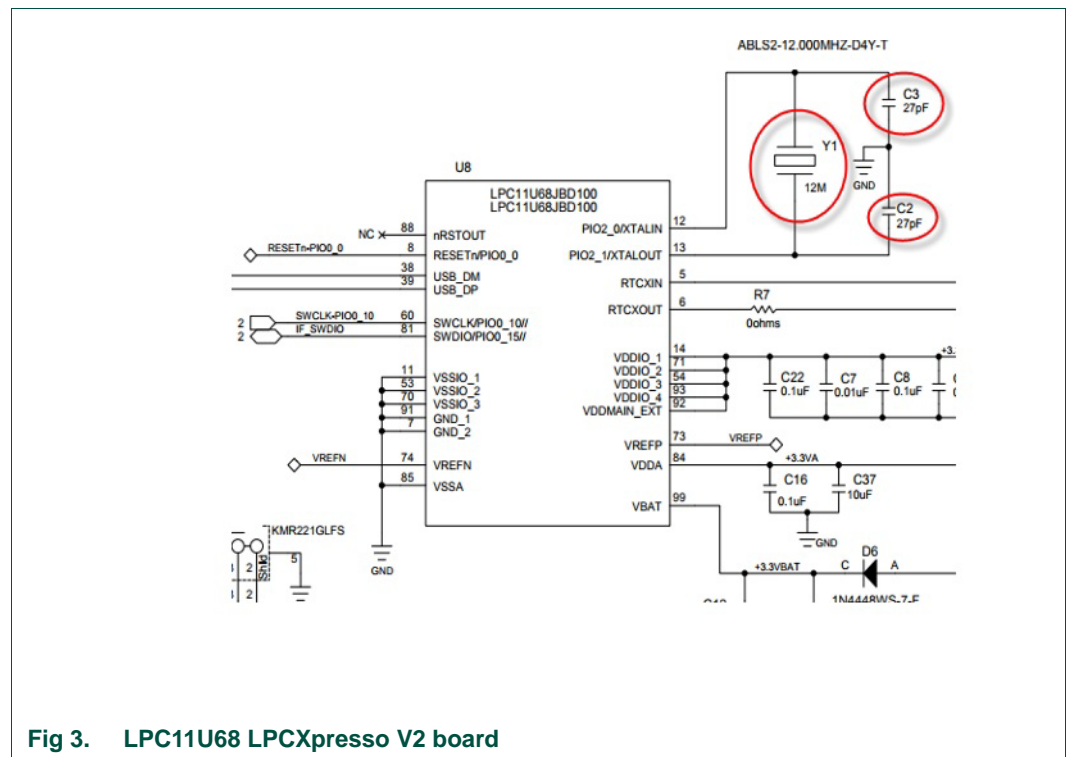


Fig 3. LPC11U68 LPCXpresso V2 board

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