Technical Note

TN_162

Bus Powered with Power Switching Configuration

Version 1.0

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This is a technical note describing the use of Bus Powered USB with Power Switching Configuration in all FTDI products.

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1 Introduction

FTDI datasheets may have a power configuration section which shows Bus Powered USB with Power Switching Configuration. This design was intended for 5V IO. However FTDI products can operate at 3.3V IO which requires a slight modification to the circuit as described in this technical note.

1.1 Overview

FTDI products provide a simple but effective method of turning off power to external logic during the USB suspend mode. A requirement of USB bus powered applications, is when in USB suspend mode, the application draws a total current of less than 2.5mA. This requirement includes external logic. Some external logic has the ability to power itself down into a low current state by monitoring the PWREN# signal.

1.2 Scope

This document describes the use of USB Bus Powered with Power Switching Configuration for 5V and 3.3V IO.

2 Power Switching Configuration Basics

The PWREN# signal is used to control the power switch.

PWREN# output is low after the device has been configured by USB, then high during USB suspend mode.

This signal is used as the gate input to a P-Channel MOSFET to control the power to external logic.

A suitable device to do this is an International Rectifier IRLML6402, or equivalent. It is recommended that a "soft start" circuit consisting of a 1kΩ series resistor and a 0.1µF capacitor is used to limit the current surge when the MOSFET turns on. Without the soft start circuit it is possible that the transient power surge, caused when the MOSFET switches on, will reset the FTDI IC or the USB host/hub controller.

With power switching controlled designs the following should be noted:

- The external logic to which the power is being switched should have its own reset circuitry to automatically reset the logic when power is re-applied when moving out of suspend mode.

- Set the Pull-down on Suspend option in the internal FTDI IC memory.

- The CBUS Pin should be configured as PWREN# in the internal FTDI IC memory, and used to switch the power supply to the external circuitry.

- For high-power USB bus powered applications (one that consumes greater than 100mA, and up to 500mA of current from the USB bus), the power consumption of the application must be set in the Max Power field in the internal FTDI IC memory.

- PWREN# gets its power source from VCCIO. For designs using 3V3 logic, ensure VCCIO is not powered down using the external logic. In this case use the +3V3OUT.
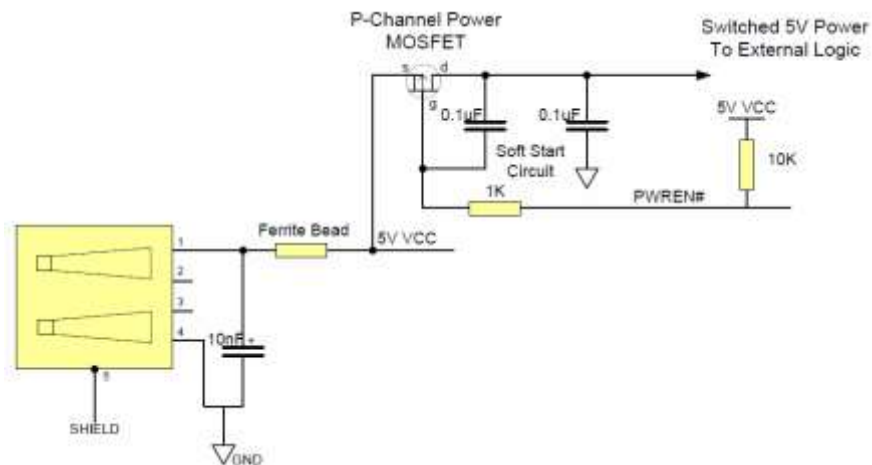


Figure 2.1 Power Switch Example

3 Configurations

3.1 5V IO Configuration

The correct configuration can be found in the FT232R/FT245R datasheet as shown in Figure 3.1 below. The IC is configured for 5V IO operation.

This also applies to FT2232D and FT232B/FT245B.

When the device has been configured by the USB Host, PWREN# is low meaning that the gate voltage turns on the external logic supply through the MOSFET.

When the device is in USB suspend mode, PWREN# is high meaning that the gate voltage turns off the external logic supply through the MOSFET.
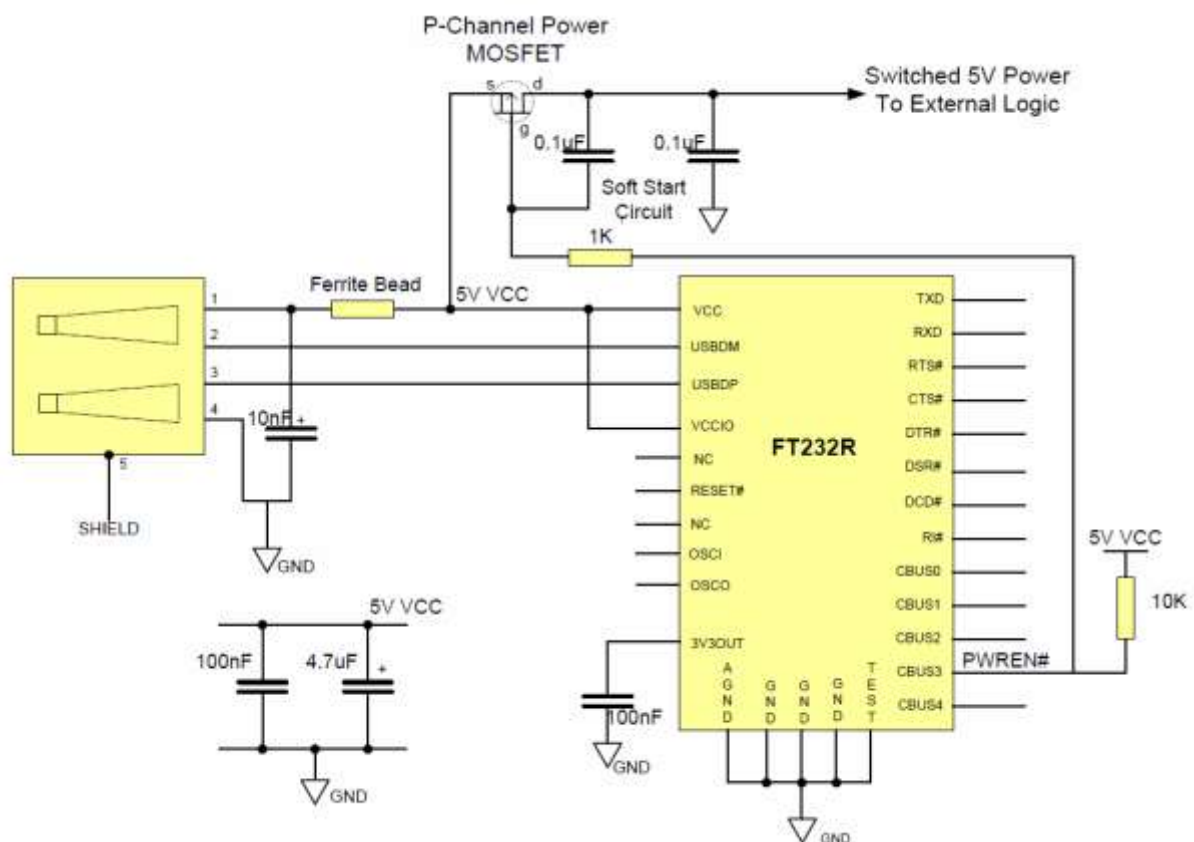

Figure 3.1 FT232R/FT245R Configuration

These devices can also be configured for 3.3V IO. In this configuration, see section 3.2.

3.2 3V3 IO Configuration

The configuration below, as shown in the FT-X Series ICs datasheets, results in the MOSFET not completely turning off in USB suspend mode, since the device operates at 3.3V IO. This also applies to the FT232H, FT2232H and FT4232H which are 3.3V IO devices.

Since the MOSFET source voltage is 5V and the gate voltage is only 3.3V, the gate of the MOSFET will be at -1.7V relative to the source. This exceeds the threshold voltage of the IRLML6402 MOSFET.

The result is that the MOSFET doesn't power off completely.
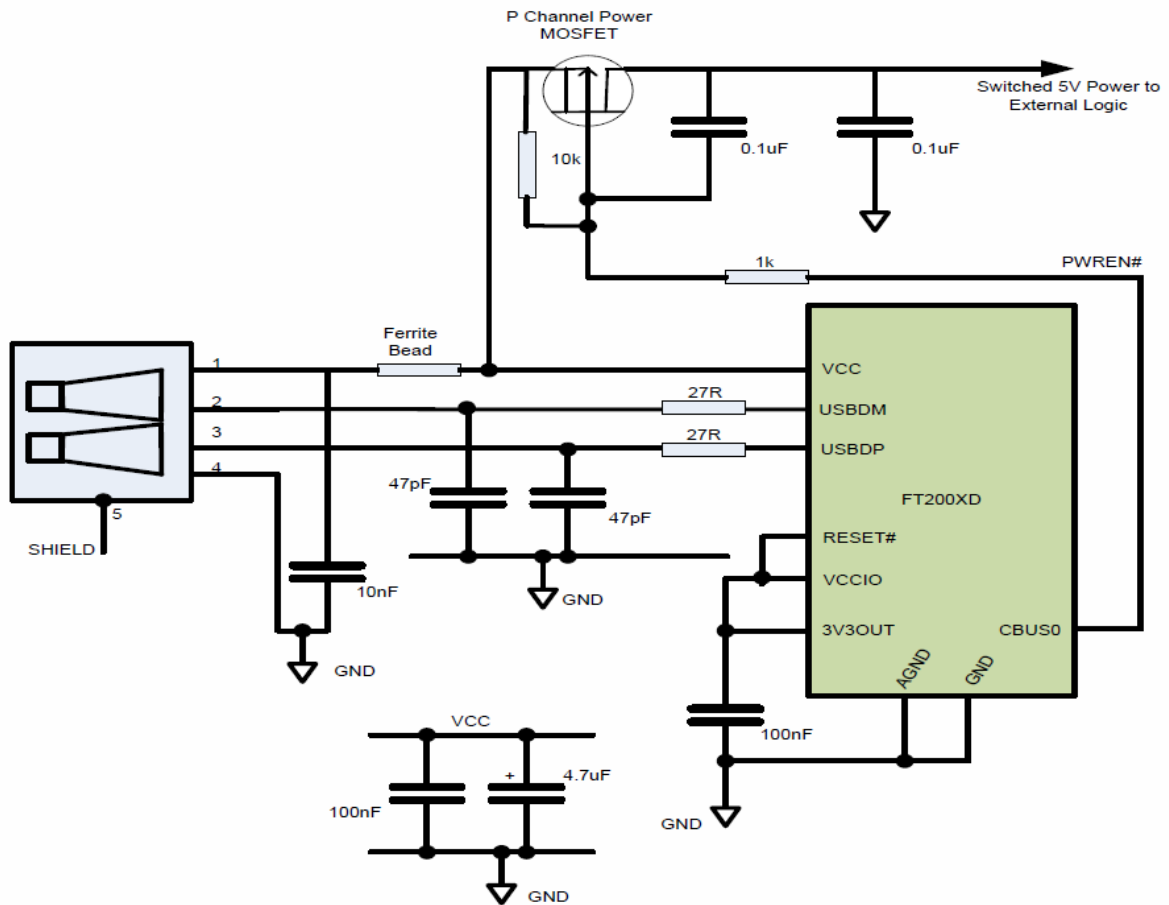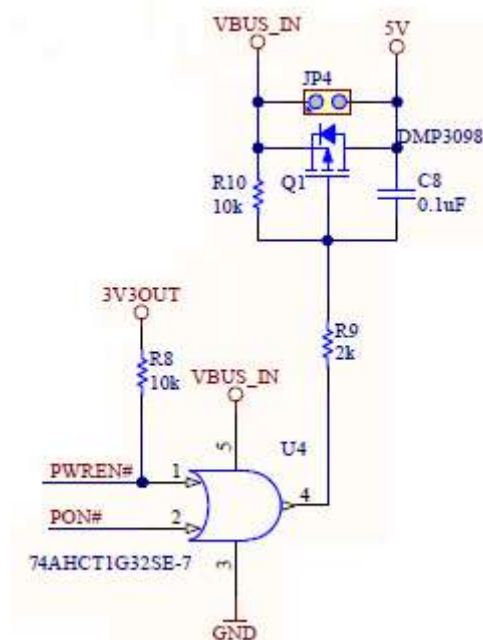

Figure 3.2 FT-X Configuration

4   Workaround

When using 3.3V IO, there is a workaround available that requires an additional external component.

4.1 Using a Non-inverting Buffer

A non-inverting buffer can take a 3.3V signal and output a 5V signal referenced from VBUS (5V).

Figure 4.1 below shows a 2-input OR Gate taking PWREN# signal and an optional additional power on signal as the inputs. VCC is connected to VBUS for 5V output signal levels.

This would mean that when in USB suspend mode PWREN# is 3.3V and the OR gate output would be a 5V input to the MOSFET gate.

Figure 4.1 Buffer Configuration

Another suitable device is a Fairchild Semiconductor NC7ST32, or equivalent.

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Distributor and Sales Representatives

Please visit the Sales Network page of the FTDI Web site for the contact details of our distributor(s) and sales representative(s) in your country

Appendix A – References

Document References

http://www.ftdichip.com/Products/ICs.htm

Acronyms and Abbreviations

Terms	Description
IC	Integrated Circuit
IO	Input Output
MOSFET	Metal–Oxide–Semiconductor Field-Effect Transistor
USB	Universal Serial Bus

Appendix B – List of Tables & Figures

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Appendix C – Revision History

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Document Feedback: Send Feedback

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1.0	Initial Release	2017-06-09