USB to SPI Bridge

Hardware Manual

Revision 1.0

Revision History

Revision	Date	Description	Author
1.0	October 11th, 2017	Initial Release	Divino

Contents

1 Introduction

The Matrix Orbital USB to SPI Bridge utilizes FTDI's FT232H IC, allowing users to communicate to their SPI devices through a USB interface. Made specifically to be used with the Matrix Orbital EVE2 series of displays, the USB to SPI Bridge can help decrease development time and reduce development hardware complexity. The USB to SPI Bridge provides additional features, including:

- Native USB protocol. No USB specific firmware programming required
- USB 2.0 Hi-speed (480Mbits/Second) and full speed (12Mbits/Second) compatibility
- Multi-Protocol Synchronous Serial Engine (MPSSE) to simplify SPI communication
- Standard Mini-B USB header for Communication and Power
- Barrel Jack Power input for optional 5-15V input
- Configuration options for transmit and receive LED drive signals
- Plug and play usability

More information on FTDI's FT232H IC can be found on FTDI's FT232H Product page, available online

2 USB to SPI Bridge

2.1 Overview

The USB to SPI Bridge uses a single channel USB 2.0 Hi-Speed to UART/FIFO IC. It is fully compliant with the USB 2.0 specification, and has been configured as a USB to SPI interface. This allows SPI devices to be controlled from a PC or a USB interface, with sustained SPI data transfer speeds of up to 30MBits/second.

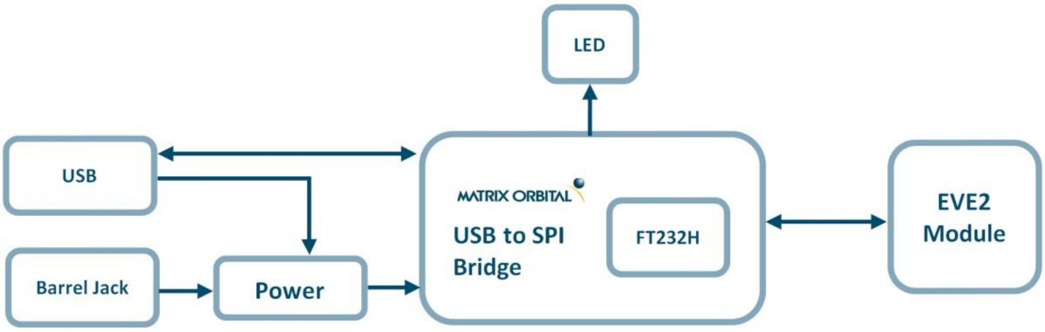


Figure 1: USB to SPI Bridge Block Diagram

3 USB to SPI Bridge Headers

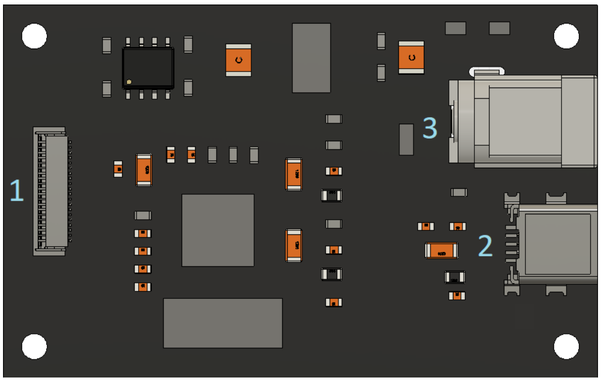


Figure 2: USB to SPI Bridge Header Locations

Table 1: List of available Headers

#	Header	Standard Mate
1	SPI Communication and Power	FFC-20P*
2	USB Communication and Power	EXTMUSB3FT/INTUSB3FT
3	Power Adapter	PWR-ACDC-5V2A

***Note:** The FFC-20P cable is included as part of our USB to SPI Development Kit

3.1 SPI Communication and Power Header

The 20 pin FFC header on the USB to SPI Bridge is used to interface with an SPI device, such as an EVE2 Display Module. This FFC header will mate with any 20 pin FFC cable with a 0.5mm pitch and bottom contacts, such as the Wurth Electronics INC 687620050002 series ribbon cable.

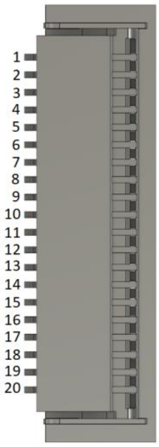


Figure 3: 20 Pin SPI connector

Pin	Symbol	Type	Function
1	Vout	Power	Logic Voltage (3.3V)
2	GND	Ground	Ground Connection
3	SCK	Input	SPI clock input
4	MISO	Input/output	SPI MISO output
5	MOSI	Input/output	SPI MOSI input
6	CS	Input	SPI slave select input*.
7	$\overline{\text{INT}}$	Open Drain Output	Interrupt to host**
8	RST		FT81x Reset pin
9	NC	No connection	No connection
10	AUDIO	Output	Audio PWM out
11	IO2	Input/output	General purpose IO 0
12	IO3	Input/output	General purpose IO 1
13	GPIO2	Input/output	General purpose IO 2
14	GPIO3	Input/output	General purpose IO 3
15	GND	Ground	Ground connection
16	Vout	Power	Logic Voltage (3.3V)
17	NC	No connection	No connection
18	NC	No connection	No connection
19	NC	No connection	No connection
20	NC	No connection	No connection

***Note:** The CS pin signifies when a SPI transaction occurs by going active low. When the pin goes inactive high, the write operation is considered complete.
****Note:** Open drain output (default) or push-pull output. Active low

3.2 USB Communication and Power Header

USB protocol offers an easy connection to any host computer. The simple and widely available protocol can be accessed using the familiar Mini-B USB connector to fulfil communication needs.

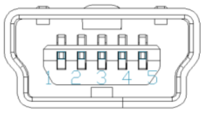


Figure 4: Mini USB Header

Table 2: Mini-USB Pinout

Pin	Function
1	Vin
2	D-
3	D+
5	Gnd

The USB can be connected to virtually any USB host using the appropriate cable; however, additional power can be supplied through the Power Adapter. Most commonly used with a PC, this connection creates a virtual com port that offers a simple power solution with a familiar communication scheme.

3.3 Power Adapter

A power adaptor may be applied to the USB to SPI Bridge to provide power to the bridge board and display. When choosing an adaptor, please ensure it is a centre positive model that conforms to the voltage and current requirements of the USB to SPI Bridge, and display. Please consult the Electrical Characteristics section for details.

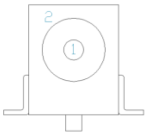


Figure 5: Power Adaptor Header

Table 3: Power Adaptor Pinout

Pin	Function
1	VCC
2	Gnd

4 USB Drivers

A USB driver is required to communicate with the USB to SPI Bridge. These drivers can be downloaded from https://www.matrixorbital.ca/drivers/usb-drivers and installed through device manager. Once installed, the USB to SPI Bridge will appear as a “Matrix Orbital USB 2 SPI Driver” in device Manager.

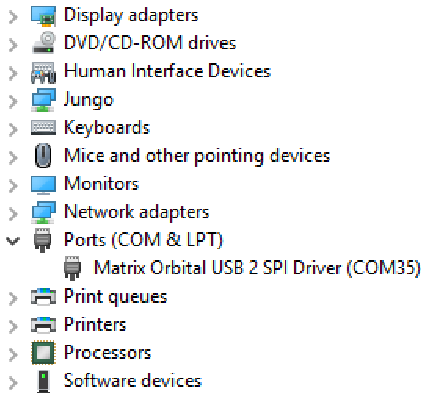


Figure 6:USB to SPI Bridge Drivers Installed

Please note that the Matrix Orbital USB to SPI Bridge drivers are derived from FTDI’s FT232H Drivers, but have been modified for this product to include specific settings, such as unique VID and PID values. More information about FTDI’s drivers is available on FTDI’s Driver page online.

5 MPSSE Library

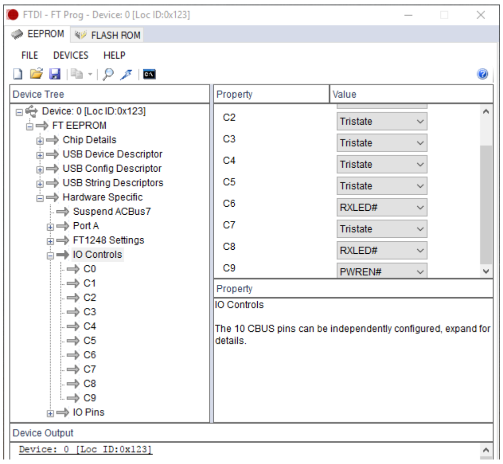
A Multi-Protocol Synchronous Serial Engine (MPSSE) is available on the USB to SPI Bridge. This mode is enabled by sending a software command (FT_SetBitMode) to the USB to SPI Bridge driver. Using the MPSSE, the USB to SPI Bridge has been configured for an industry standard SPI (MASTER) interface.

For more information about the MPSSE Library, and how to use it, see FTDI's application note AN135 – MPSSE Basics. In addition, the MPSSE command set is fully described in application note AN108 – Command Processor for MPSSE and MCU Host Bus Emulation Modes.

6 Configurable LED Options

A single LED is connected to both the ACBUS6 and ACBUS8 pins USB to SPI Bridge and can be configured to indicate the current state of the bridge. The USB LED can be configured to pulse when data is being transmitted and/or received, when the board is powered, or when the board is asleep.

The LED's can be configured using the FT_PROG software utility, which can be downloaded from FTDI'S Utilities page online.



Property	Value
C2	Tristate
C3	Tristate
C4	Tristate
C5	Tristate
C6	RXLED#
C7	Tristate
C8	RXLED#
C9	PWREN#

Property

IO Controls

The 10 CBUS pins can be independently configured, expand for details.

```
Device: 0 [Loc ID:0x123]
```

Figure 7: FT_PROG Configuration

Figure 8: Configurable USB LED

Please be aware that when the USB to SPI Bridge board is configured for SPI communication using the MPSSE library, all ACBUS functions are overwritten, including the Configurable LED Options. The MPSSE library will need to be modified to reactivate ACBUS settings for the USB to SPI Bridge.

7 Communication Setup

In order to setup the USB to SPI Bridge, the MPSSE library is first linked. For more information regarding the MPSSE SPI library, see application note AN_178 Programming Guide for libMPSSE - SPI. Using the MPSSE library, a call can be sent to determine how many, if any, FT-series devices are currently connected to the host. Once it is confirmed that a device is connected, information about that device can be retrieved, and a handle can be opened for that device. The following code snippet uses the MPSSE library to determine what device is connected to the host, and then creates a handle for the device.

```
ft_bool_t  Ft_Gpu_Hal_Init(Ft_Gpu_HalInit_t *halinit)
{
        Init_libMPSSE();
        SPI_GetNumChannels(&halinit->TotalChannelNum);
        if (halinit->TotalChannelNum > 0)
        {
                FT_DEVICE_LIST_INFO_NODE devList;
                SPI_GetChannelInfo(0, &devList);
        }
        return TRUE;
}
```

With the handle opened, the channel can then be configured for SPI communication using specific op-codes. The code snippet below configures MPSSE for SPI communication, initializes the channel, and assigns it to the host.

```
ft_bool_t  Ft_Gpu_Hal_Open(Ft_Gpu_Hal_Context_t *host)
{
        ft_bool_t ret = TRUE;
        ChannelConfig channelConf //channel configuration
        FT_STATUS status;

          /* configure the spi settings */
        channelConf.ClockRate = host->hal_config.spi_clockrate_khz * 1000;
        channelConf.LatencyTimer= 2;
        channelConf.configOptions = SPI_CONFIG_OPTION_MODE0 | SPI_CONFIG_OPTION_CS_DBUS3
        |SPI_CONFIG_OPTION_CS_ACTIVELOW;
        channelConf.Pin = 0x00000000;/*FinalVal-FinalDir-InitVal-InitDir (for dir 0=in, 1=out)*/

        /* Open the first available channel */
        SPI_OpenChannel(host->hal_config.channel_no,(FT_HANDLE *)&host->hal_handle);
        status = SPI_InitChannel((FT_HANDLE)host->hal_handle,&channelConf);
        printf("\nhandle=0x%x status=0x%x\n",host->hal_handle,status);
        host->spichannel = 0;

        return ret;
}
```

Once configured, data can be sent through the USB to SPI Bridge to the SPI device. Data can be read and written by using specific MPSSE commands below.

```
SPI_Write(host->hal_handle, &value, sizeof(value), &SizeTransfered, SPI_TRANSFER_OPTIONS_SIZE_IN_BYTES);

SPI_Read(host->hal_handle, &value, sizeof(value), &SizeTransfered, SPI_TRANSFER_OPTIONS_SIZE_IN_BYTES);
```

At the end of the program, or when the USB to SPI Bridge is no longer needed, the MPSSE SPI channel can be closed and the MPSSE Library link can be cleaned up.

```
ft_void_t Ft_Gpu_Hal_Close(Ft_Gpu_Hal_Context_t *host)
{
        host->status = FT_GPU_HAL_CLOSED;
        /* Close the channel*/
        SPI_CloseChannel(host->hal_handle);
}

ft_void_t Ft_Gpu_Hal_DeInit()
{
        Cleanup_libMPSSE();
}
```

8 Compatibility list

The USB to SPI Bridge is compatible with the current EVE2 line up offered by Matrix Orbital.

Table 4: Compatibility List

EVE2 Series	Compatibility
EVE2-29A-BLM-TPN	✓
EVE2-35A-BLM-TPN	✓
EVE2-35A-BLM-TPR	✓
EVE2-38A-BLH-TPR	✓
EVE2-43A-BLM-TPN	✓
EVE2-43A-BLM-TPR	✓
EVE2-50A-BLM-TPN	✓
EVE2-50A-BLM-TPR	✓
EVE2-70A-BLM-TPN	✓
EVE2-70A-BLM-TPR	✓

9 Appendix

9.1 Environmental

Table 5: Environmental limits

Operating Temperature	0°C to 50°C
Storage Temperature	-20°C + 70°C

9.2 Electrical Characteristics

Table 6:Input Electrical Characteristics

Parameter	Min	Typ	Max	Unit
Supply Voltage (Vin)	4.5	5	15	V
Supply Current	80	-	-	mA
USB Data (D+/D-)	-0.5	3.3	3.63	V

Table 7: Output Electrical Characteristics

Parameter	Min	Typ	Max	Unit
Output Voltage (Vout)	3.22	3.3	3.35	V
Output Current	10	-	800	mA
Output (High)	2.4	3.3	-	V
Output (Low)	-	0	0.4	V

9.3 USB to SPI Bridge Dimensional Drawing

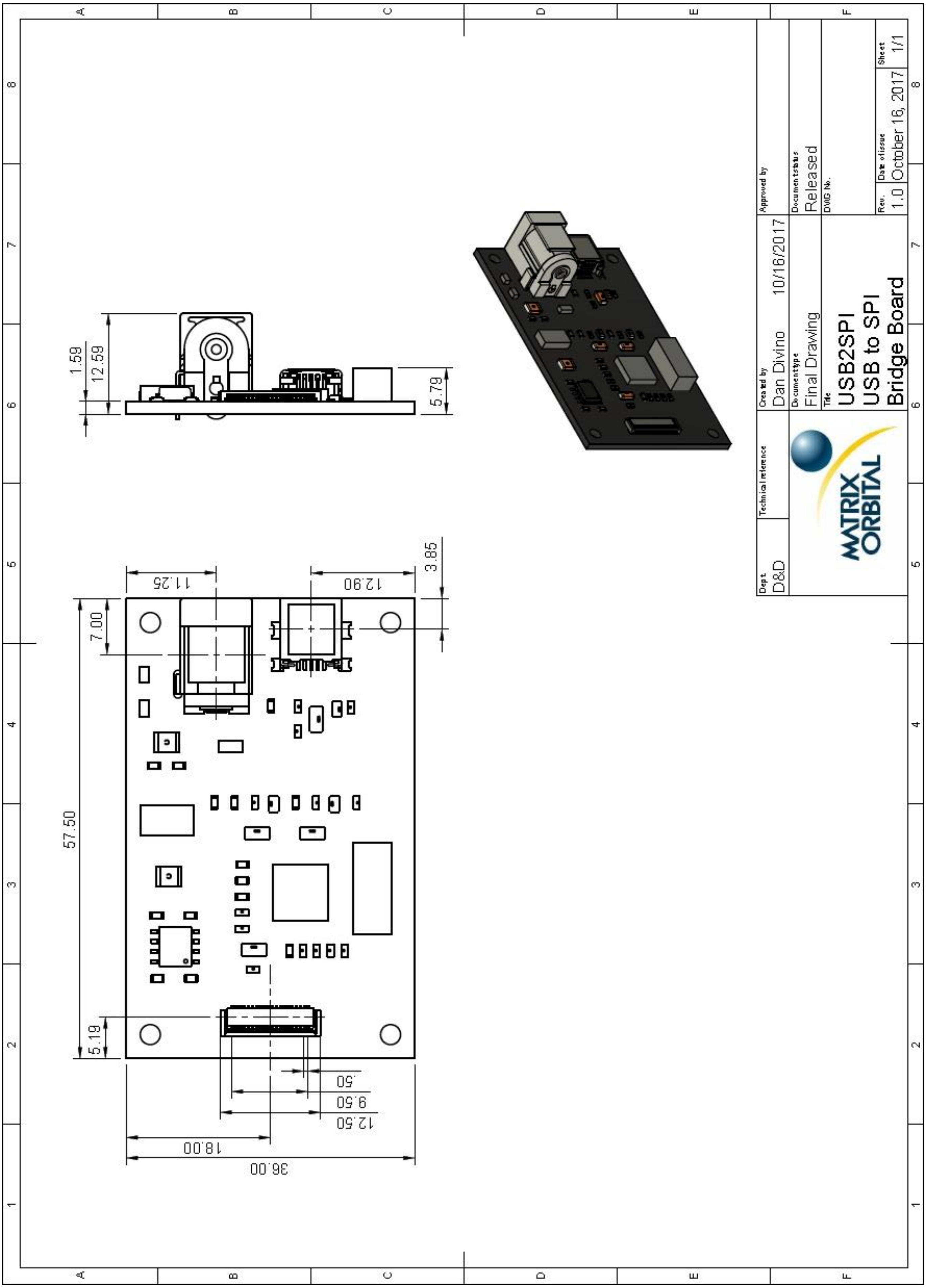


Figure 9: USB to SPI Bridge Technical Drawing

9.4 USB to SPI Bridge Schematic

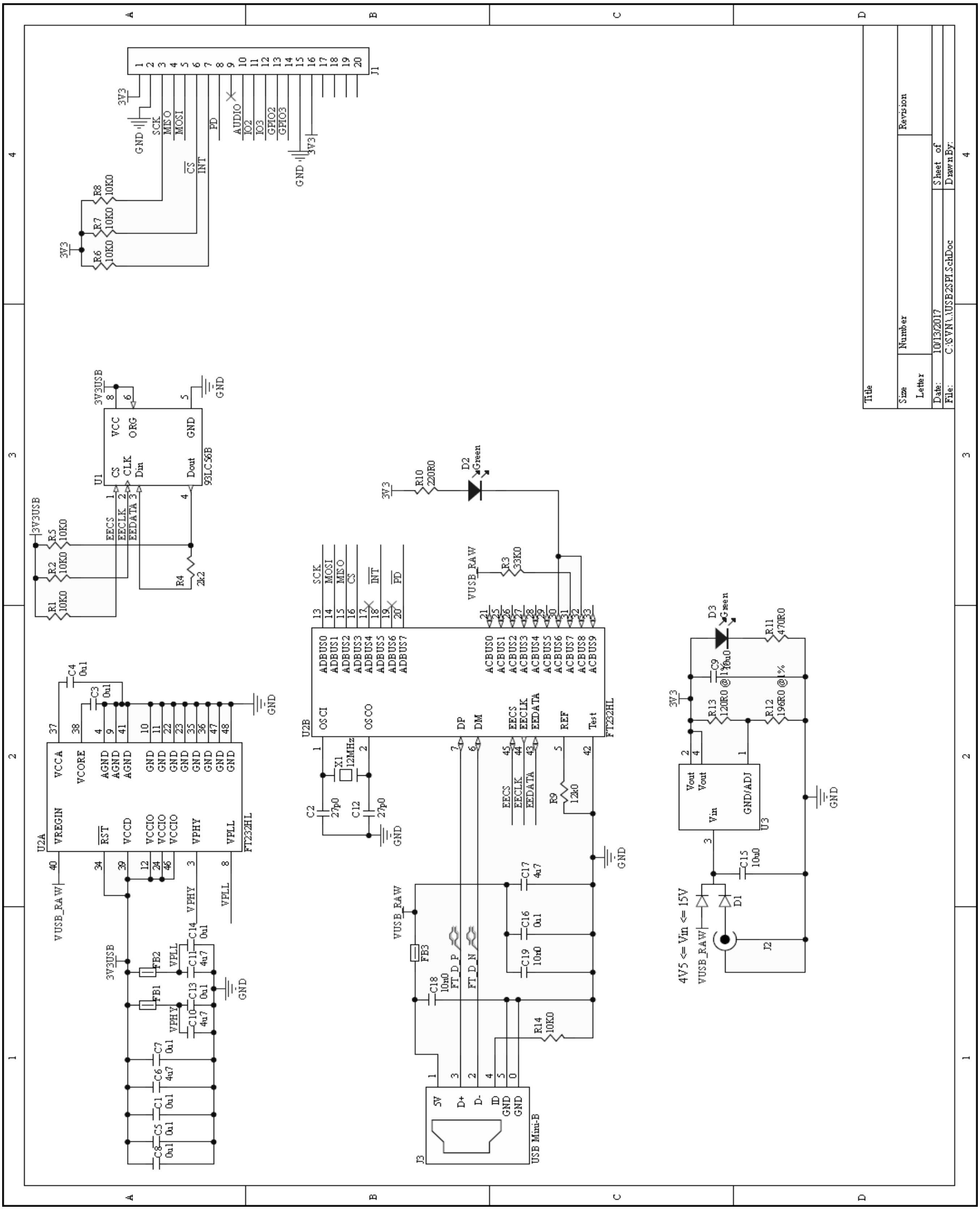


Figure 10: USB to SPI Bridge Schematic

10 Contact

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