FUSB302 - Type-C Interface Detection Solution

User's Manual – FUSB302 Evaluation Board FM141014D

Table of Contents:

Overview

The FUSB302 evaluation board and included software allows customers a complete platform to evaluate the Type-C interface detection solution the FUSB302 provides. The evaluation board is designed for both stand-alone operation and connection to test equipment for specific testing requirements. The FUSB302 software provides both fully automatic control and manual control of the FUSB302 functions. With a single connection to a PC and a couple configurations in the GUI, the evaluation board can function as a Source, Sink or Dual Role port.

Applications Board Diagram

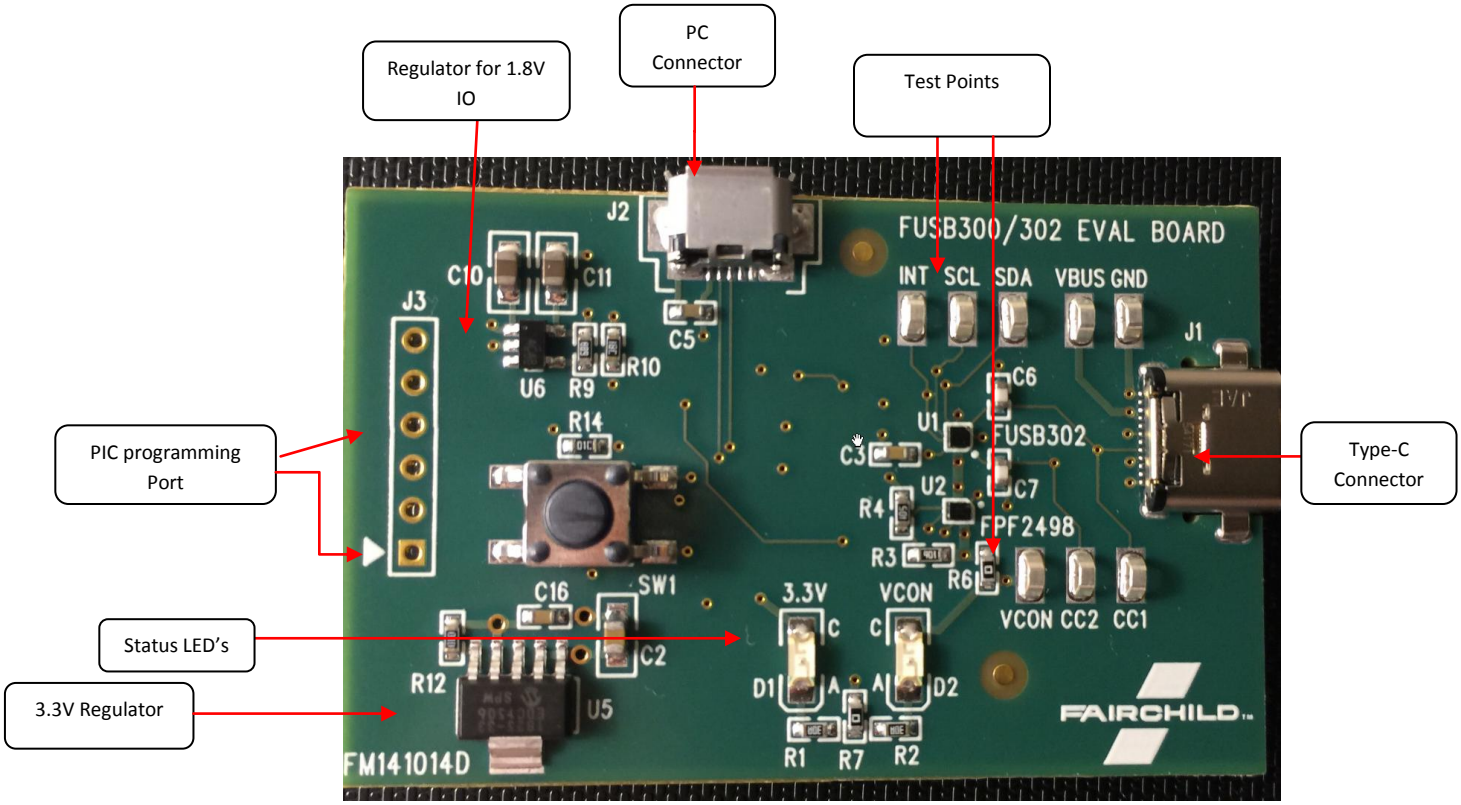


Figure 1 Evaluation Board Layout

Power Configuration

The FUSB302 evaluation board is designed to be able to be powered from just the PC connection or powered externally based on the testing requirements.

Power Supplied From Board

The FUSB302 can fully operate from the VBUS input of the micro-B USB receptacle J2. To operate the evaluation board, the USB power should be provided to the board over the micro-B USB. Then, the on board regulator generates VDD, which is 3.3volt for device supply. Once valid USB power is provided, the indicator LED, 3.3V, will be turned on.

I2C Communication

Communication with the FUSB302 is done through I2C accesses. The evaluation board allows different ways of connecting I2C masters to the FUSB302.

Direct I2C Connection

Customers that want to directly connect their I2C masters to the evaluation board can connect the I2C master signals to the SCL, SDA and INT_N test points .

PIC I2C Connection

The evaluation board uses a PIC32MX250F128 micro-controller as an I2C master to control the FUSB302. This is the communication method used by the FUSB302 GUI. By connecting the PC to the micro-B USB receptacle J2, the evaluation board automatically powers the microcontroller and connects the I2C master to the FUSB302. The evaluation board automatically generates a regulated 1.8V supply, U6, which is used by an external I2C translator to set the I2C levels used with the FUSB302.

Type-C Signal Connections

The FUSB302 evaluation board allows different ways of connecting to another Type-C device or controlling the signals of the Type-C receptacle based on the type of testing that is required.

CC pins

The Type-C CC1 and CC2 pins are directly connected to the Type-C receptacle J1 on the board. There is also a test point for each pin that can be used to connect the CC pins externally. Note that the FUSB302 evaluation board contains the minimum cReceiver capacitance specified in the USB PD specification for the CC pins which is 200pF. This capacitance is C6 and C7 in the schematic.

VBUS

VBUS is used differently based on the Type-C port type. As a device/UFP port, VBUS is directly connected to the Type-C receptacle J1 and the VBUS test point located near J1. As a host/DFP port, VBUS can be supplied to the receptacle either externally or controlled by the FUSB302 GUI. To supply VBUS externally, connect VBUS to the VBUS test point located near the Type-C receptacle J1. When controlled by the FUSB302 software, VBUS can be supplied from the PC connection, micro-B. The FUSB302 software uses an on board load switch to control the enabling of VBUS to the Type-C receptacle.

NOTE: VBUS_IN must be kept to 12V or lower for proper operation when controlled by the FUSB302 GUI.

VCONN

VCONN can be supplied to the FUSB302 either externally through the VCONN test point. The VCONN test point can be easily found near CC1 and CC2 test points. To supply VCONN from the VBUS pin of the PC connection, use wire line between Vbus and Vconn test points. Note that the evaluation board has 10uF on VCONN input of the FUSB302 which is the minimum bulk capacitance specified in the Type-C specification. This capacitance is C4.

USB2.0 and SBU

They're left open in the Type-C connector and no connections in the board.

Status LED's

The following status LED's are provided on the evaluation board.

LED	Status
D1	VDD is supplied to FUSB302
D2	VCONN is supplied to FUSB302

Schematic

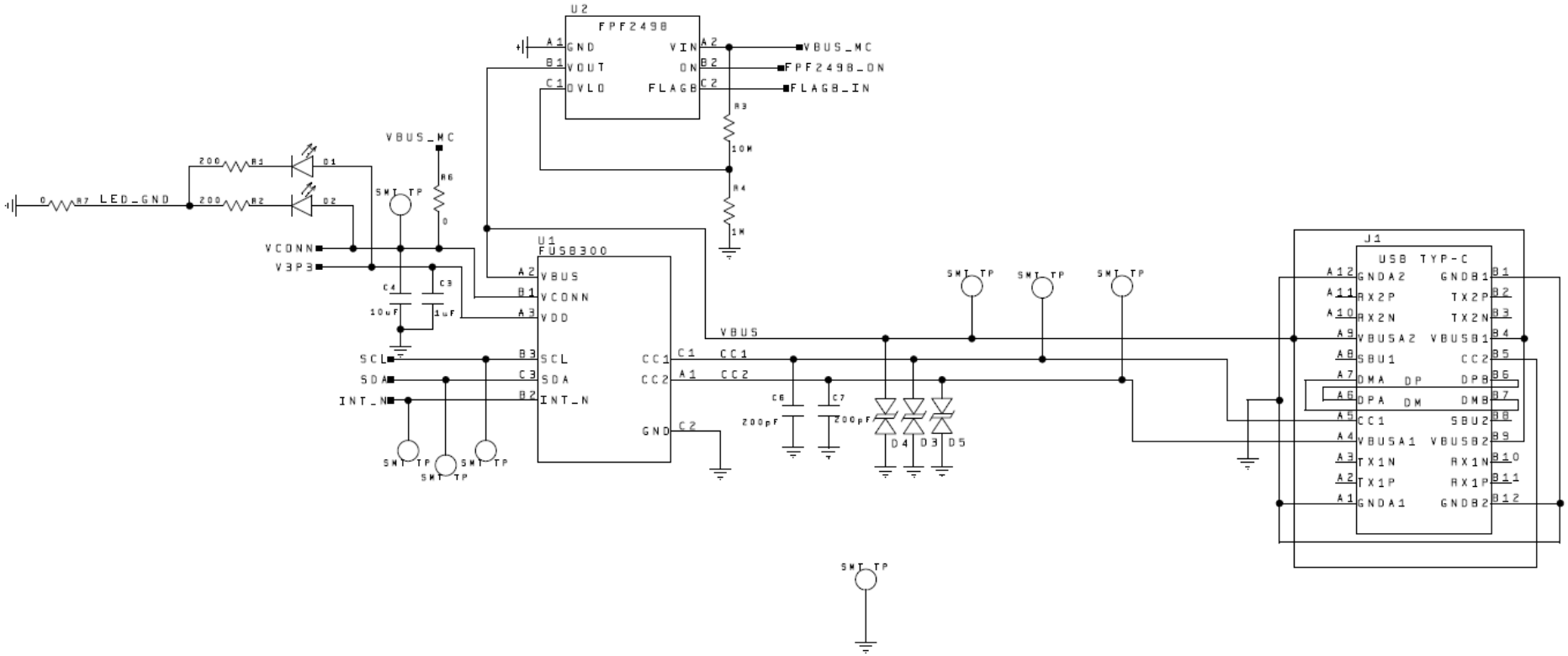


Figure 2 FUSB302 Evaluation Board FM14101C Schematic (1/2)

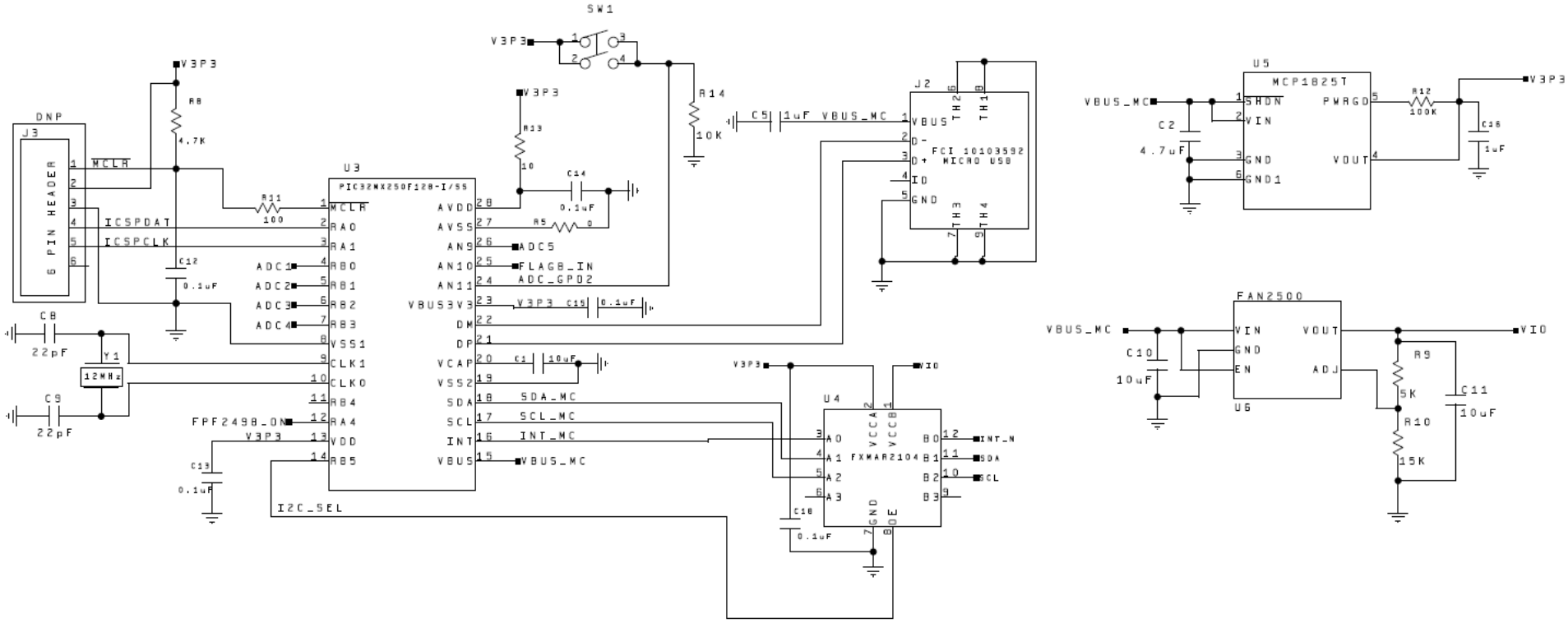


Figure 3 FUSB302 Evaluation Board FM14101C Schematic (1/2)

FUSB302 Evaluation Platform GUI Configuration

GUI Installation

Instructions for installing Fairchild FUSB302 Control Software

1. Close down all applications on PC.
2. Locate and run the file “setup.exe” (versions of the file will include the release number). This takes a few seconds and automatically runs the program. The executable file "FUSB302 GUI" is installed into the computers Start Menu under "Fairchild Semiconductor". (After installation, program may automatically start.)
    a. You may get a security warning that the “Publisher cannot be verified.” Click install to finish the installation process.
    b. It is possible that you may be required to install Microsoft Framework .NET. The program is written in VB.NET, which utilizes Microsoft Framework.
3. Plug the STD-A end of the USB Cable into the USB port of your PC.
4. Plug the Micro-B end of the USB Cable into the GUI Interface, J2, On the Evaluation Board. V3P3 LED will illuminate if properly connected.)
5. Wait for the USB Port to connect with a message in the lower left hand corner of the GUI that states “USB: Standard HID connected” and the message background should be green. If the message background remains red and states “USB: Not Connected”, then there is a connection problem.

To start the GUI in the future, click the Start menu on your computer, then “All Programs” at the bottom, then the “Fairchild Semiconductor” folder, and finally the “FUSB302 GUI” application:

> Start > All Programs > Fairchild Semiconductor > FUSB302 GUI

See User's manual for operation of board and software.

Upgrading the GUI software:

1. Terminate the FUSB302 program if it is running.
2. Open the Control Panel: Start, Control Panel
3. Click on Add/Remove programs.
4. Select the ‘FUSB302 GUI’ program.
5. Uninstall.
6. Repeat the installation process above.

GUI Operation

Program startup

To operate the FUSB302 Evaluation Platform, perform the following steps:

1. Install the FUSB302 GUI software as described in the previous section.
2. Connect the FUSB302 board to your computer with a micro-USB cable provided.
3. Configure power on main board.
4. Start the GUI software by clicking the Start Menu, “All Programs”, the “Fairchild Semiconductor”, and then "FUSB302 GUI".
5. The base operation GUI will appear as shown in Figure 4 below.

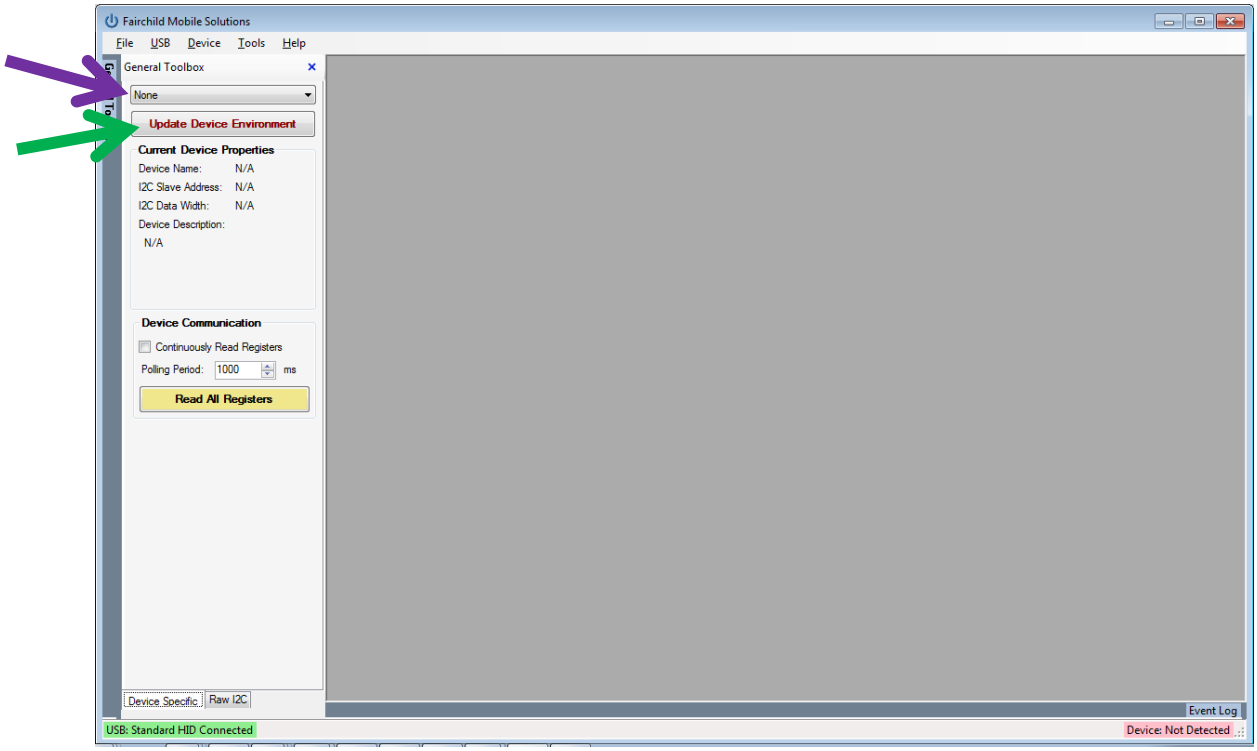


Figure 4

6. Click the drop down box that says “None”, as marked by the purple arrow in Figure 4. Select “FUSB302”.
7. Click the “Update Device Environment” button, as marked by the green arrow in Figure 4. The device control for the FUSB302 will now load and look like Figure 5. The lower right part of the screen will now indicate “Device: FUSB302 Detected” with a green background. If this is not shown, there is a likely a power configuration issue with the FUSB302 device.

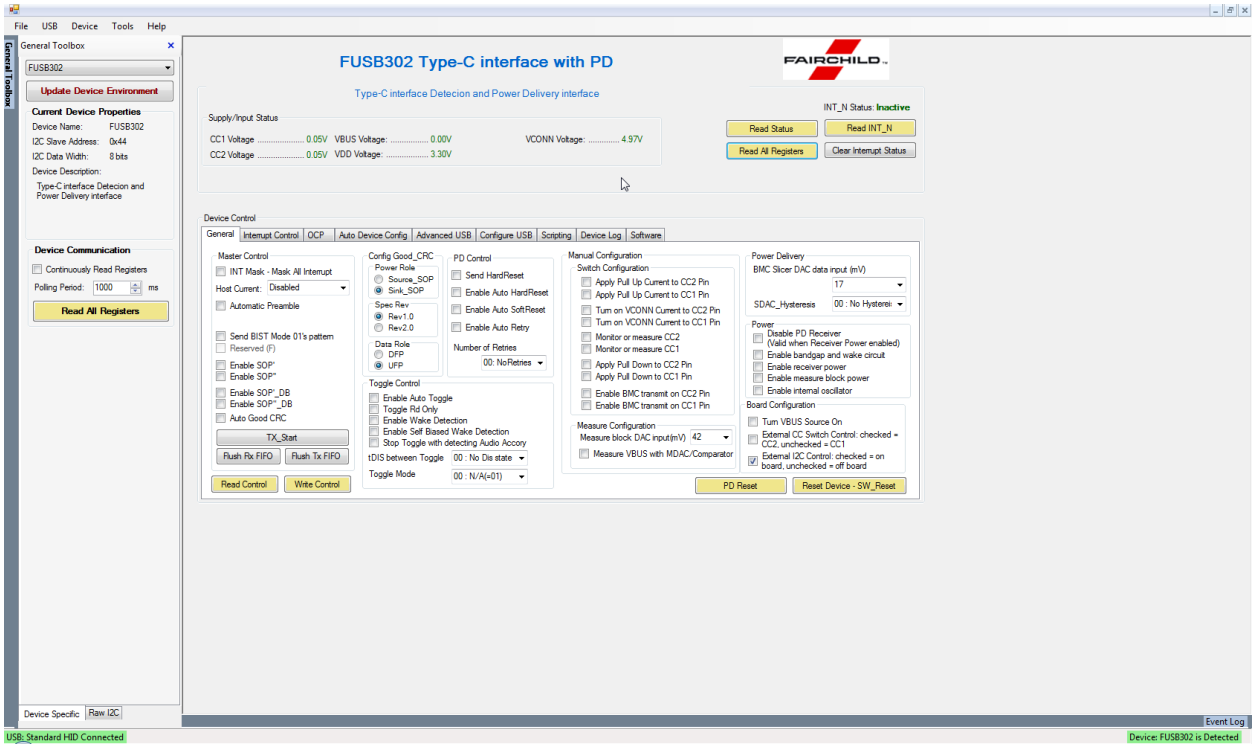


Figure 5

You can now read, write, and configure the FUSB302. Accessories can be plugged in and used.

Using the GUI

There are two basic modes of operation using the FUSB302 GUI:

- Manual operation using the 'General' tab
- Autonomous operation using the 'Auto Device Config' tab.

These two modes should not be used together, as it will interfere with the autonomous mode state machine. Status information is shown in the top half of the window, as well as in the 'Interrupt Control' tab and the 'Device Log' tab. Scripts can also be loaded in the 'Scripting' tab for easier loading of multiple sequential steps.

More information on specific operation of each section of the GUI is provided in the following sections.

File Menu

- "File"
  - Click "Exit" to exit the FUSB302 GUI program.
- "USB"
  - For proper operation, select "Standard HID"
  - The I2C frequency can be modified with "Select I2C Frequency." The default value is 40000 (Hz).
  - Select "Autoconnect" to automatically select USB interface type (Standard HID).
- "Device"
  - Select "Register Map" to open the full register map, providing read and write capability.
- "Tools"
  - "Options": currently there is no functionality with this selection.
- "Help"
  - "About" provides version information.

General Toolbox – Device Specific Tab

- "Update Device Environment" button
  - Reloads device GUI
- Current Device Properties
  - Provide basic I2C information and description.
- Device Communication
  - Provides functionality to read all registers by clicking the button and to continuously read all registers by selecting the checkbox. The polling period to continuously read all registers is programming with the numerical up-down box.
  - It is not recommended to use this feature in autonomous device configuration mode, as it will interfere with interrupt operation.

General Toolbox – Raw I2C Tab

The raw I2C capability is selected through a tab at the bottom of General Toolbox section.

- The slave address and number of bytes can be selected. Proper configuration for the FUSB302 is slave address "0x44" and 1 byte.
- Individual byte read and write capability functionality is achieved through entering the desired address and (write) data and then clicking the "Read" or "Write" button.

Supply/Input Status

CC1, CC2, VCONN, VBUS, and VDD are measured through ADC's on the external on board PIC32. These are useful for monitoring voltage levels of the lines during different modes of operation and for debug. Status information is automatically updated if the 'Automatically Poll Output Voltage' checkbox is checked on the 'Software' tab. NOTE: Due to the impedance requirements of the CC pins, the ADC readings for the CC pins are not intended to be accurate but indicate generally what the voltage is.

Reading Interrupt Pin, Status, and all Registers

If automatic updates are not enabled in the 'Software' tab, the interrupt pin, status registers, and all registers can be individually updates by clicking the respective button on the right of the screen.

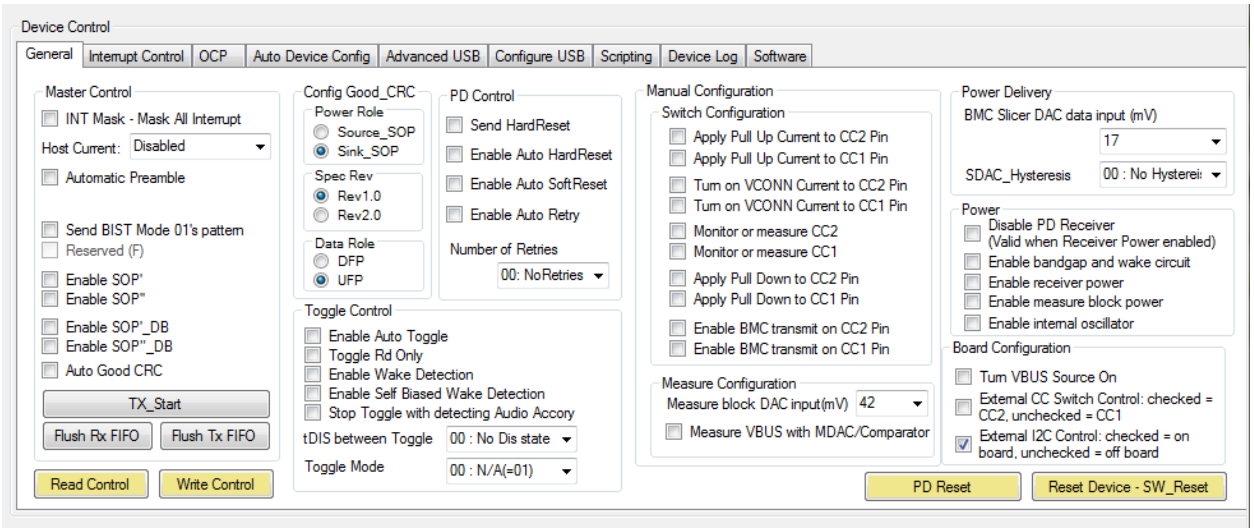
Device Control Tabs

Tabs on the bottom half of the screen provide detailed control and monitoring of the FUSB302. The sections below describe how to use these controls.

General

The 'General' control tab provides manual control for all FUSB302 configuration registers:

- The 'Master Control' section programs the Control0 and Control1 registers.
- The 'Manual Configuration' section programs the Switches0 and Switches1 registers
- The 'Measure Configuration' section programs the Measure register.
- The 'Power Delivery' section programs the Slide register.
- The 'Power' section programs the Power register.
- The 'Board Configuration' section provides control over additional features on the FUSB302 evaluation board:
    - 'Turn VBUS Source On' enables the onboard FPF2498 to route 5V power to the VBUS line. This feature enables to board to provide VBUS during host (DFP) modes of operation.
    - 'External CC Switch Control' enables the board to control an external SuperSpeed switch based on the CC1/CC2 status. This signal is on the SWCTL test point on the bottom right hand corner of the evaluation board.
    - 'External I2C Control' switches the PIC32 I2C to control an external FUSB302 device instead of the FUSB302 on that evaluation board. This feature is for future use and to use the on board FUSB302, this box must remain checked.

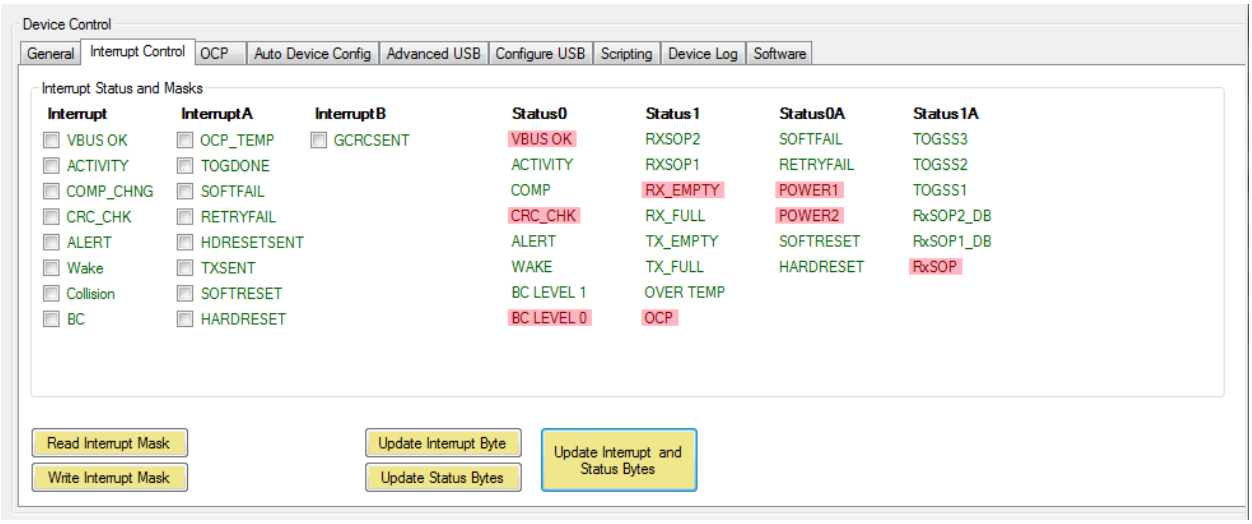


To manually program the FUSB302, select the desired configuration, and click the ‘Write General Control’ at the board of the tab. To find out the current register settings of the FUSB302, click the ‘Read General Control’ button and the GUI will read the registers and update them on the screen. These read and write buttons apply the settings in all the boxes except the ‘Board Configuration’ box, which immediately updates the board configuration when a box is checked. The TX_Start, TX_Flush, and RX_Flush bits are clear on write (COW) and have an intended use of to execute immediately. For this reason when the button is clicked, that bit will also be written immediately. (A read is done first to check the state of all the other bits in the respective register and so when the button is click, only that respective bit changes, all other bits will stay the value they were in the register.)

To perform a software reset on the FUSB302, click the ‘Reset Device – SW_Reset’ button in the lower right had corner of the tab.

Interrupt Control

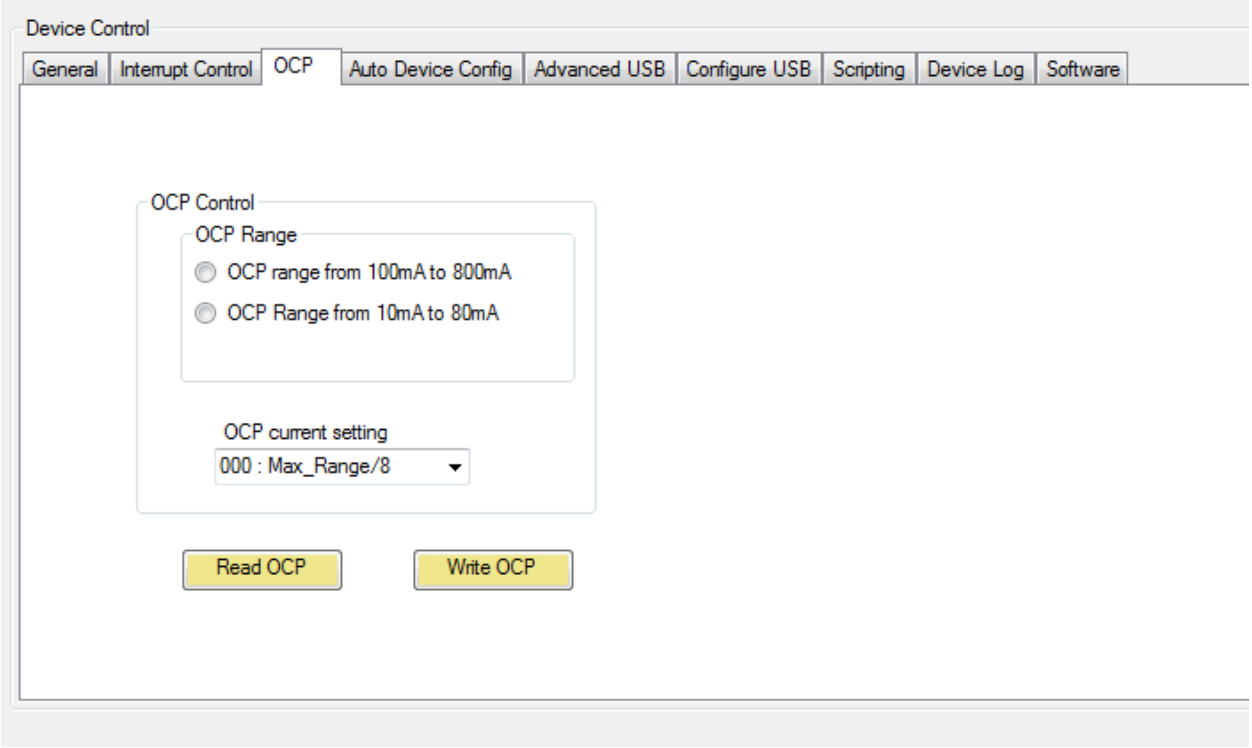
All interrupt and status bits are represented in this tab. To mask any interrupt bits, click the desired check box next to the bit name, and then click 'Write Interrupt Mask' at the bottom of the screen. To get the current state of the mask in the FUSB302, click the 'Read Interrupt Mask' button.



The current state of the interrupt and status bits is represented by the color of the bit name. Green represents a '0' in the register bit. Red, with a red background, represents a '1' in the register bit. These bits can be set to update automatically in the 'Software' tab, or can be updated manually using the buttons at the bottom of the tab.

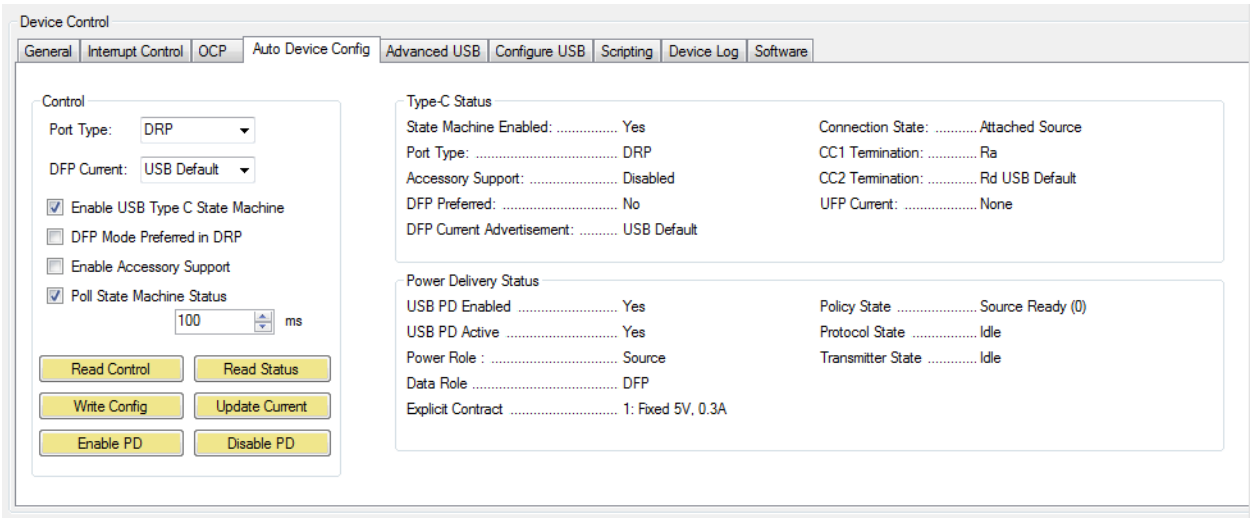
OCP

The ‘OCP’ tab implements control for the OCPreg control register.



Auto Device Config

The 'Auto Device Config' tab implements functional Type-C state machines to configure the FUSB302 evaluation board as an Upstream Facing Port (UFP), Downstream Facing Port (DFP), or Dual-Role Port (DRP) interface. To configure the device to the desired state, select either 'UFP', 'DFP', or 'DRP' in the 'Port Type' drop down box in the 'Control' section. Then select the desired host current for DFP modes. Checkboxes for optionally configuring the device for DFP Preferred Mode in DRP and the Accessory Support are provided.



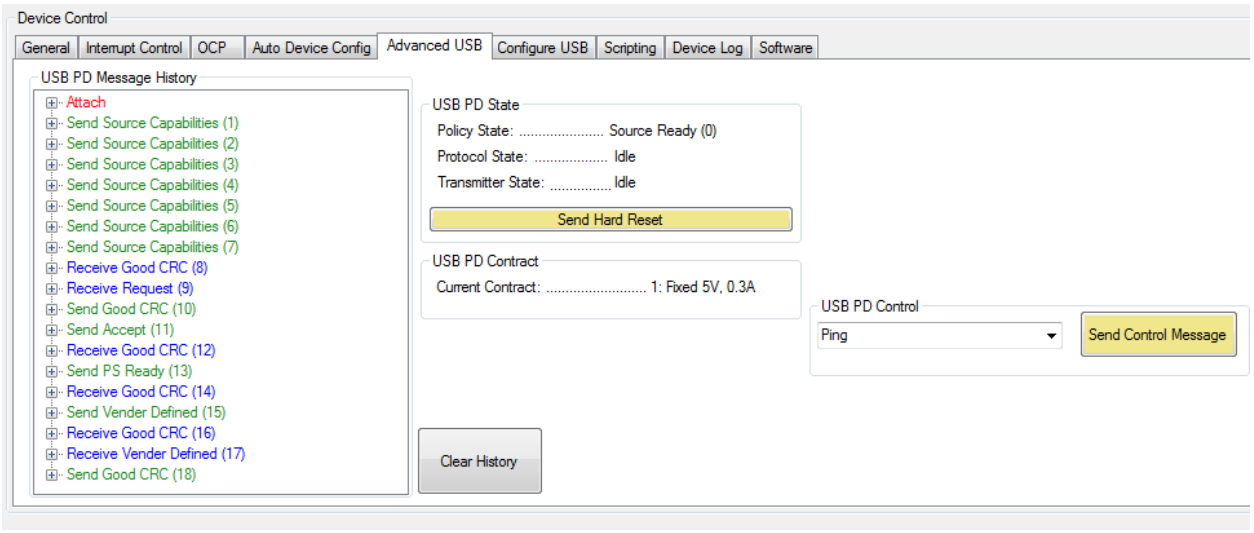
The autonomous Type-C State Machine control is enabled and disabled by selecting the checkbox in the 'Control' section and then clicking the 'Write Config' button. Connect any desired Type-C port to the FUSB302, and the status change will be seen in the sections above the tab. When the 'Poll State Machine Status' checkbox is checked, the screen will update with the current status of the FUSB302 Type-C states, polling at a rate set by the box (in milliseconds).

The PD state machines are enabled by default when the Type-C state machine is enabled. You can enable or disable PD by clicking the appropriate button in the Control box. When the PD state machine is running, it will automatically negotiate a power contract based on what was detected on attach and the configuration in the Configure USB tab.

When the state machines are enabled, the General and Interrupt Control tabs become locked out to prevent interaction with the state machines. When the state machines are disabled, the full functionality is allowed in those tabs.

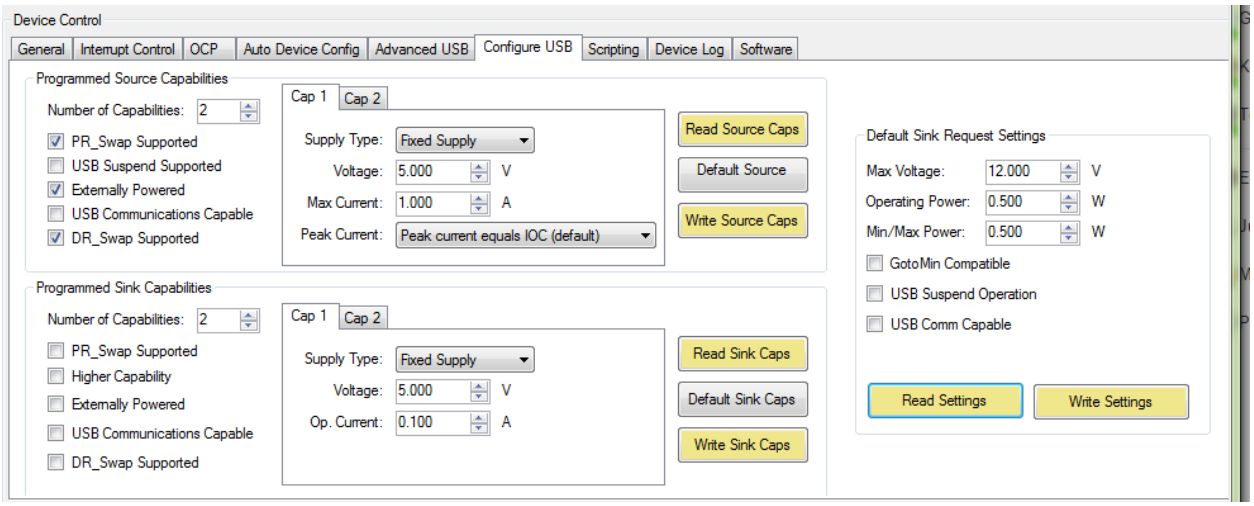
Advance USB

The 'Advance USB' tab logs any PD activity with PD Message History Box. The log file can be expanded or collapsed to show more or less detail of the PD packets. The other control boxes indicate the current state of the PD state machine and what contract was negotiated. When connected as a sink, it displays the source capabilities of the source that is attached. The user can select different capabilities and make the requests. The user can also manually send different PD messages through the pull-down menu and the click buttons.

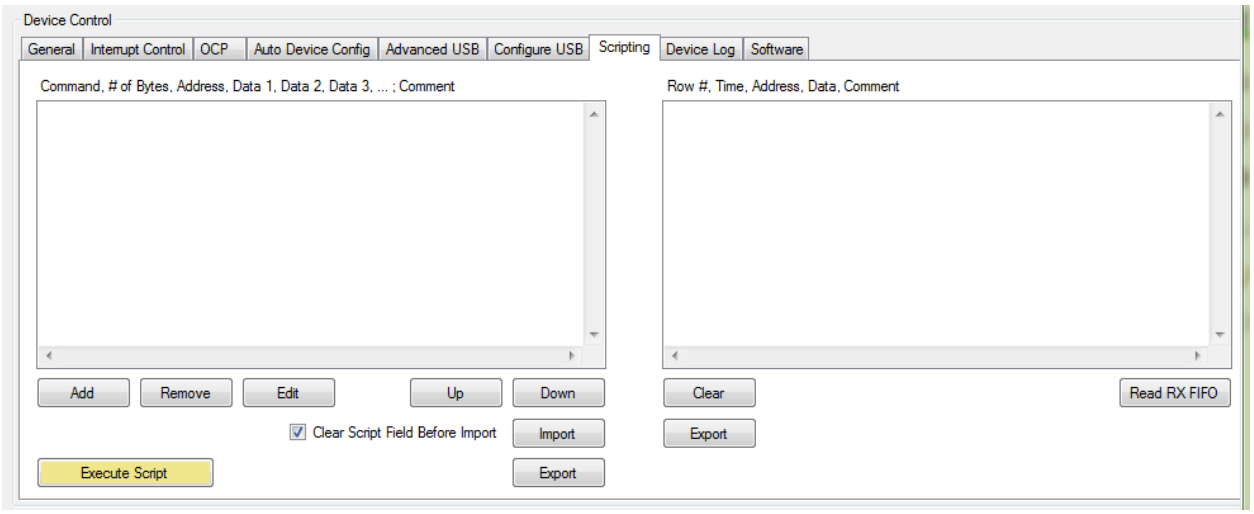


Configure USB

The 'Configure USB' tab is to set-up PD functionality of the evaluation board. The settings in this tab dictate how the PD state machine will response once a connection is made. It is the programmed source and sink capabilities of the device and the charging algorithm that is used to automatically select a source capability when connected to a source. Note, the Read Source Caps, Read Sink Caps and Read Settings need to be clicked to reflect the default settings of the PD state machine.



Scripting



The 'Scripting' tab enables the use of scripts to configure the FUSB302. The window in the left side of the tab controls the scripting. The control has the following functionality:

- Read through "r", "rd", "read"
- Write through "w", "wr", "write"
- Delay in milliseconds through "d", "del", "delay"
- Pause through "p", "pa", "pause"

Scripts can be added through the GUI using the 'Add' button or imported from an external file using the 'Import' button. Individual lines can be reordered through the 'Up' and 'Down' buttons , edited through the 'Edit' button, or deleted with the 'Remove' button. After achieving a desired setup, a script can also be exported to a file.

Each line of command should be formatted as follows:

Command, number of bytes, address, data1, data2, … ; optional comment

An example of the power delivery loopback test is given below:

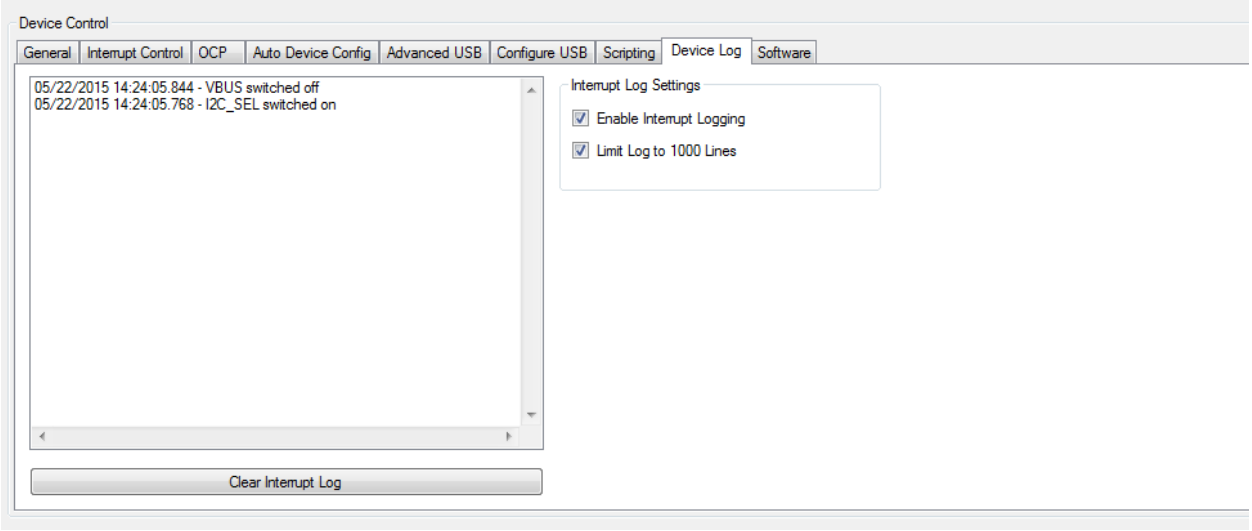
```
w,1,0x02,0x44 ; Switches0(PU_EN1, MEAS_CC1)
w,1,0x03,0x01 ; Switches1(TXCC1)
w,1,0x04,0x31 ; MDAC
w,1,0x05,0x20 ; SDAC
w,1,0x0B,0x0F; Configure Power
w,1,0x06,0x10 ; Control0(Loopback, clear int mask)
w,1,0x43,0x12 ; SOP1
w,1,0x43,0x12 ; SOP1
w,1,0x43,0x12 ; SOP1
w,1,0x43,0x13 ; SOP2
w,1,0x43,0x82 ; PACKSYM with 2 bytes
w,1,0x43,0x01 ; Data1
w,1,0x43,0x02 ; Data2
w,1,0x43,0xFF ; Jam CRC
w,1,0x43,0x14 ; EOP
w,1,0x43,0xFE ; TXOFF
w,1,0x43,0xA1 ; TXON
```

Results of an executed script are shown in the box on the right side of the tab. These results can be exported to a file.

The 'Read RX FIFO' button will automatically read the FIFO until empty and display the results in the box. This is useful to read a received power delivery packet.

Device Log

Events can be logged in the software through an onscreen box. This log can be useful in debugging and in checking the timing of various operations. Each log message has the time of day (with millisecond resolution). To stop logging to the external file, click the 'Enable Interrupt Logging' checkbox.



It is recommended to keep the 'Limit log to 1000 lines' box checked. If unchecked, the list box buffer could overflow and crash the software program. The screen can be clear with the 'Clear Interrupt Log' button at the bottom of the window.

Please Note: this log is current limited to manual mode and does not provide messages in the Auto Device Config mode.

Software

The ‘Software’ tab provides check boxes to automatically update status information:

- Polling output voltages of the ADC’s for CC1, CC2, VCONN, VBUS, and VDD.
- Updating connection status.
- Polling the Status0 and Status1 registers.
- Polling the Interrupt Pin (if the interrupt pin is set, the interrupt register will also be read).

Timers provide are programmable for the polling rate. One timer controls the polling of the bottom two check boxes.