# FUSB302GEVB

# FUSB302 Type-C™ Interface Detection Solution Evaluation Board User's Manual

ON Semiconductor®

www.onsemi.com

## EVAL BOARD USER'S MANUAL

This user guide supports the evaluation kit for the FUSB302 It should be used in conjunction with the FUSB302 data sheets as well as ON Semiconductor's application notes and technical support team. Please visit ON Semiconductor's website at www.onsemi.com.

### INTRODUCTION

The FUSB302 evaluation board (EVB) and included software allows customers a complete platform to evaluate the Type−C interface detection solution the FUSB302 provides. The EVB 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 EVB can function as a source, sink or dual−role port.

#### Description

The FUSB302 targets system designers looking to implement a DRP/DFP/UFP USB Type−C connector with low amount of programmability.

The FUSB302 does the USB Type−C detection including attach, and orientation. The FUSB302 integrates the physical layer of the USB BMC Power Delivery (PD) protocol to allow up to 100 W of power and role swap. The BMC PD block enables full support for alternative interfaces of the Type−C specification.

#### Features

- Dual−Role functionality:
  - Autonomous DRP toggle
  - Ability to automatically connect as either a source or a sink based on what has been attached
  - Software configurable as a dedicated source, dedicated sink, or dual−role
  - Dedicated devices can operate both on a Type−C receptacle or a Type−C plug with a fixed CC and VCONN channel
- Full Type−C 1.3 support. Integrates the following functionality of the CC pin:
  - Attach/detach detection as source
  - Current capability indication as source
  - Current capability detection as sink
  - Audio adapter accessory mode
  - Debug accessory mode
  - Active cable detection
- Integrates CCx to VCONN switch with over−current limiting for powering USB3.1 full featured cables
- USB PD 3.0 support
  - Automatic GoodCRC packet response
  - Automatic retries of sending a packet if a GoodCRC is not received
  - Automatic soft reset packet sent with retries if needed
  - Automatic hard reset ordered set sent
  - Support for extended/chunked messages
  - Programmable Power Supply (PPS) support
  - Basic source−side collision avoidance
- Package 9−ball WLCSP (1.215 × 1.260 mm)

### POWER CONFIGURATION

The FUSB302 EVB is designed to be able to be powered from a 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 EVB, the USB power should be provided to the board over the micro−B USB. Then, the on board regulator generates VDD, which is 3.3V 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 EVB allows different ways of connecting I²C masters to the FUSB302.

#### Direct I²C Connection

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

#### PC I²C Connection

The EVB 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 EVB automatically powers the microcontroller and

connects the I²C master to the FUSB302. The EVB automatically generates a regulated 1.8 V supply, U6, which is used by an external I²C translator to set the I²C levels used with the FUSB302.

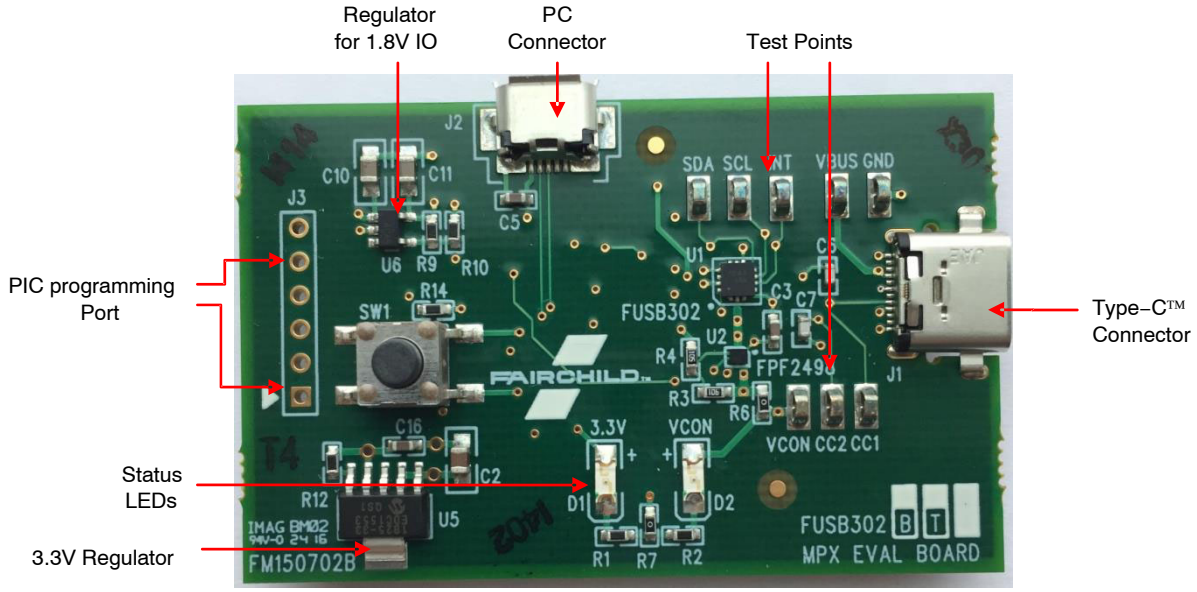


**Figure 1. EVB Layout**

## TYPE−C SIGNAL CONNECTIONS

The FUSB302 EVB 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 EVB 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 sink port, VBUS is directly connected to the Type−C receptacle J1 and the VBUS test point located near J1. As a source port, VBUS can be supplied to the receptacle J1 and controlled by the FUSB302 GUI. When controlled by the FUSB302 software, VBUS is supplied from the PC micro−B USB connection. The FUSB302 software uses an on board load switch to control the enabling of VBUS to the Type−C receptacle.

### VCONN

VCONN is supplied to the FUSB302 from the VBUS pin of the PC connection. To supply VCONN externally, remove R6 and apply the external VCONN to the VCON test point. Note that the EVB has 10˝F 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 are left open in the Type−C connector and no connections in the board.

### STATUS LEDs

The following status LEDs are provided on the EVB.

**Table 1. STATUS LEDs**

| LED | Status |
|---|---|
| D1 | VDD is Supplied to FUSB302 |
| D2 | VCONN is Supplied to FUSB302 |

## SCHEMATIC

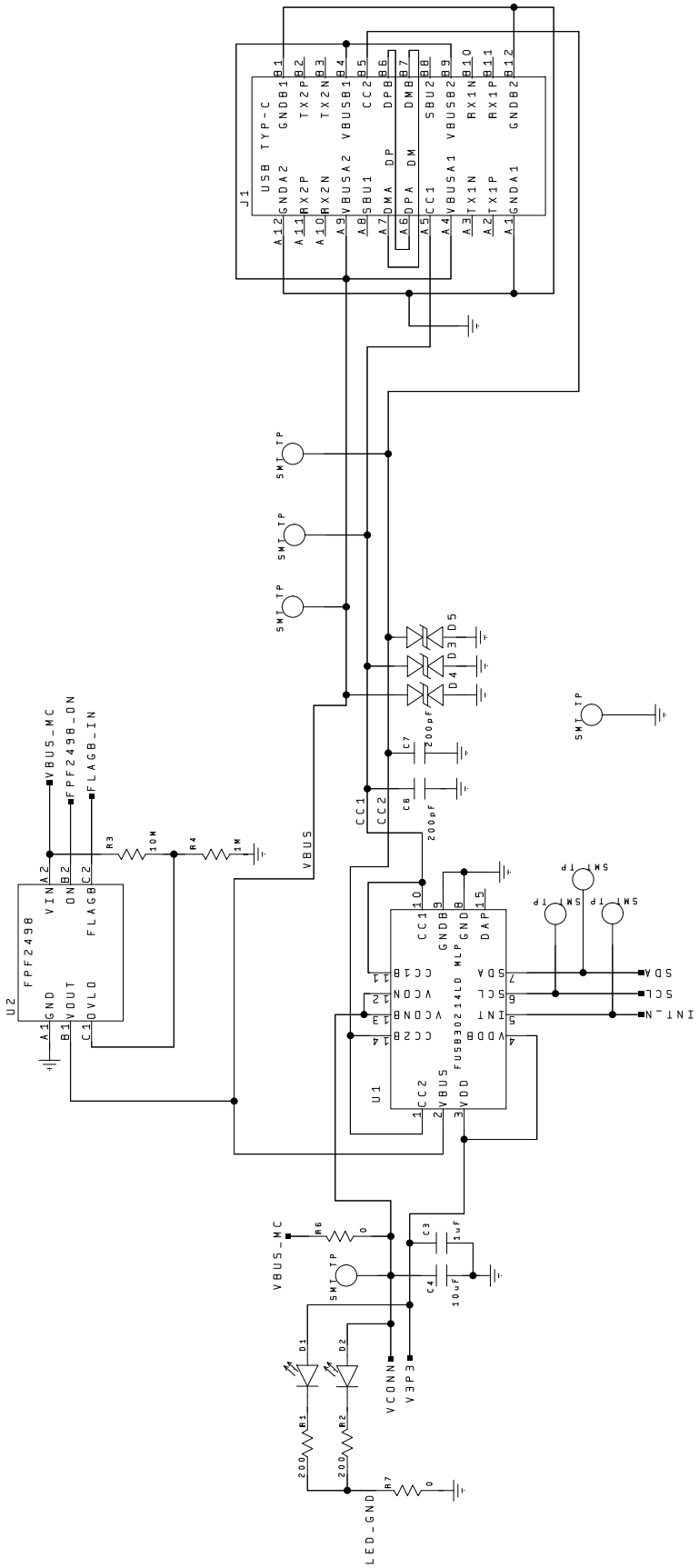


**Figure 2. FUSB302 EVB FM150702B Schematic (1/2)**

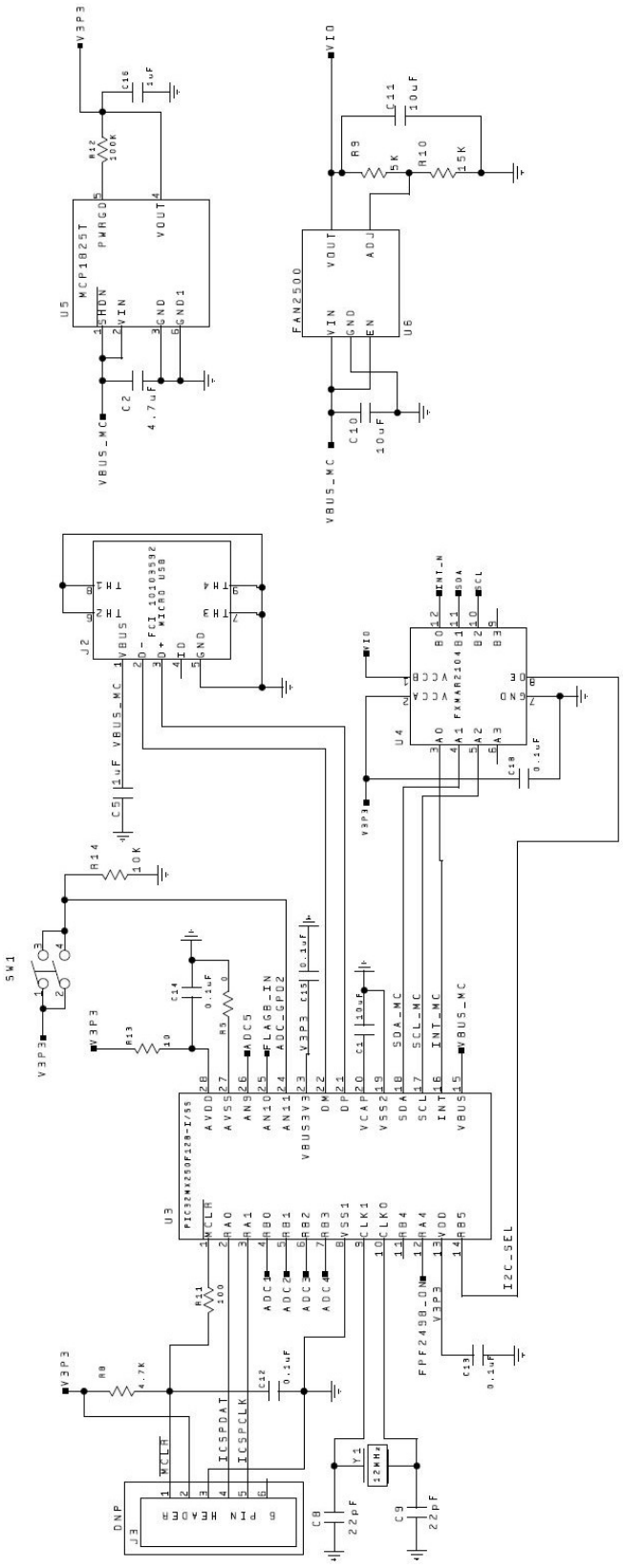

Figure 3. FUSB302 EVB FM150702B Schematic (2/2)

## FUSB302 EVALUATION PLATFORM GUI CONFIGURATION

### GUI Installation

Instructions for installing ON Semiconductor FUSB302 Control Software

1. Locate and extract the file “fusb302_gui_1_0_0_Customer.exe” (versions of the file will include the release number) from the archive file “fusb302_gui_1_0_0_Customer.7z”. The .exe can be located in any location you prefer. Double−click the .exe file to start the GUI.
2. Plug the STD−A end of the USB cable into the USB port of your PC. Plug the STD−A end of the USB Cable into the USB port of your PC.
3. Plug the micro−B end of the USB cable into the GUI Interface (J2 at the top board edge) on the EVB (3.3V LED will illuminate if properly connected).
4. Wait for the USB Port to connect with a message in the lower left hand corner of the GUI that states “USB Device: VID:0x0779 PID:0x1118”. If the message states “Disconnected”, then there is a connection problem.

Upgrading the GUI Software:

1. Simply delete the previous version of the .exe.
2. 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.
3. Start the GUI software by clicking the .exe file from the location you saved it to.
4. The base operation GUI will appear as shown in Figure 4 below.
5. The lower right part of the screen will now indicate “Device Connected v4.0.0” (the version number may be different as newer firmware is released). If this is not shown, there is a likely a power configuration issue with the FUSB302 device. If power is supplied correctly, check that the firmware was programmed correctly. The document for firmware download is posted separately. You can now read, write, and configure the FUSB302. Accessories can be plugged in and used.

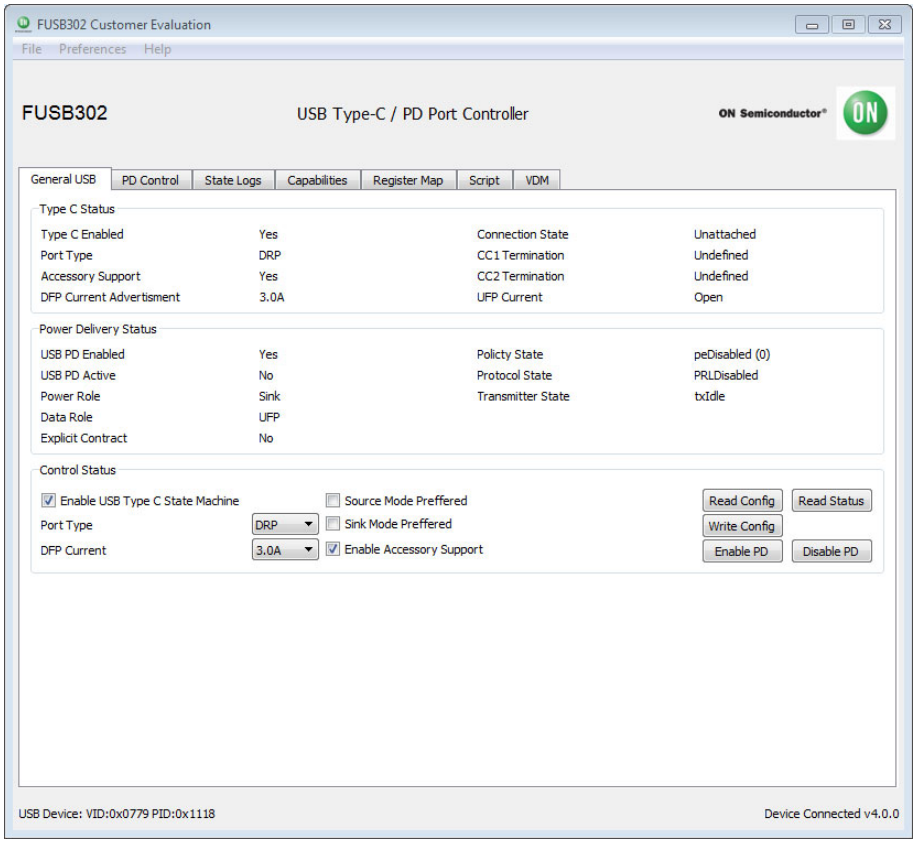


**Figure 4. Initial Page of FUSB302GUI**

## USING THE GUI

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

- Autonomous operation which uses the “Enable USB Type C State Machine” option on the “General USB” tab
- Manual operation which disables the “Enable USB Type C State Machine” option and requires manually configuring the device using all the tabs

These two modes should not be used together, as it will interfere with the autonomous mode state machine. Type−C Status and Power Delivery Status information is shown in the “General USB” tab as well as in the “State Logs” tab. Scripts can also be entered in the “Script” 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.

### Application Menu Bar

- “File”
  - Click “Exit” to exit the FUSB302 GUI program
- “Preferences”
  - Select “Auto Poll” for the GUI to continuously poll the FUSB302 for register and log updates
- “Help”
  - “About” provides GUI version information

### Device Control Tabs

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

### General USB

The “General USB” tab implements functional Type−C state machines to configure the FUSB302 EVB as a Dual−Role Port (DRP), Sink Port, or Source Port interface. When first attaching the EVB, the options in the “Control Status” section are automatically updated. To configure the device to the desired state, select either “DRP”, “Sink”, or “Source” in the “Port Type” drop down box, then click the “Write Config” button to update the FUSB302.

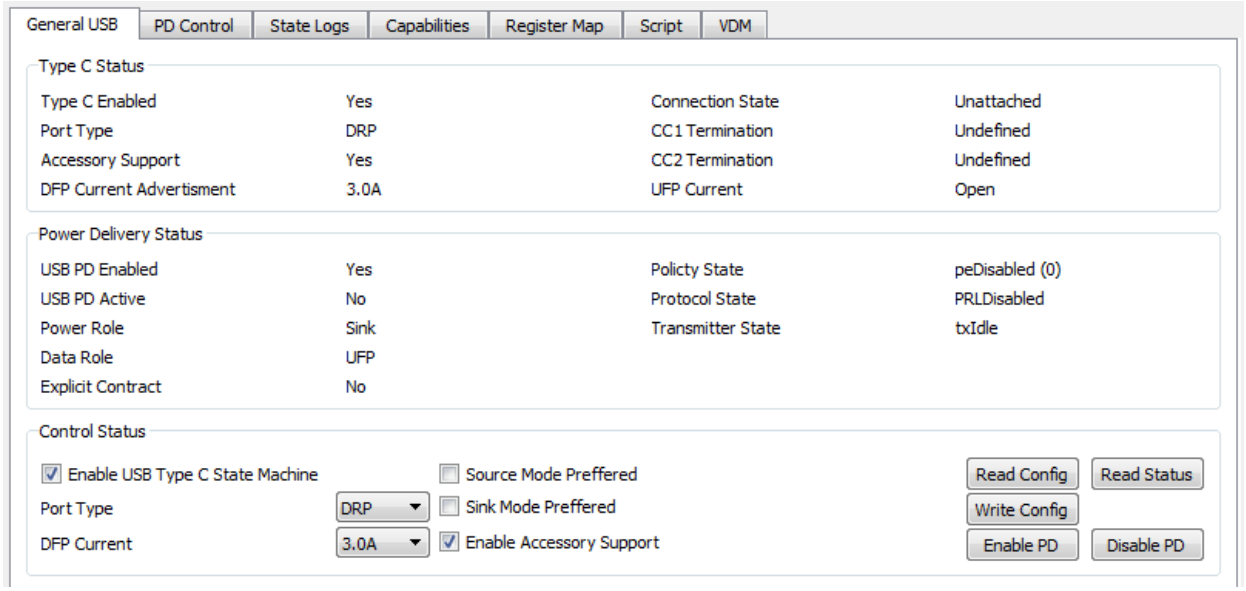


**Figure 5. General USB Tab**

The autonomous Type−C State Machine control is enabled and disabled by selecting the checkbox 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 Status sections.

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 Status section. 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 “Capabilities” tab.

### PD Control

The “PD Control” tab logs any PD activity in the USB PD Message History window. 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.

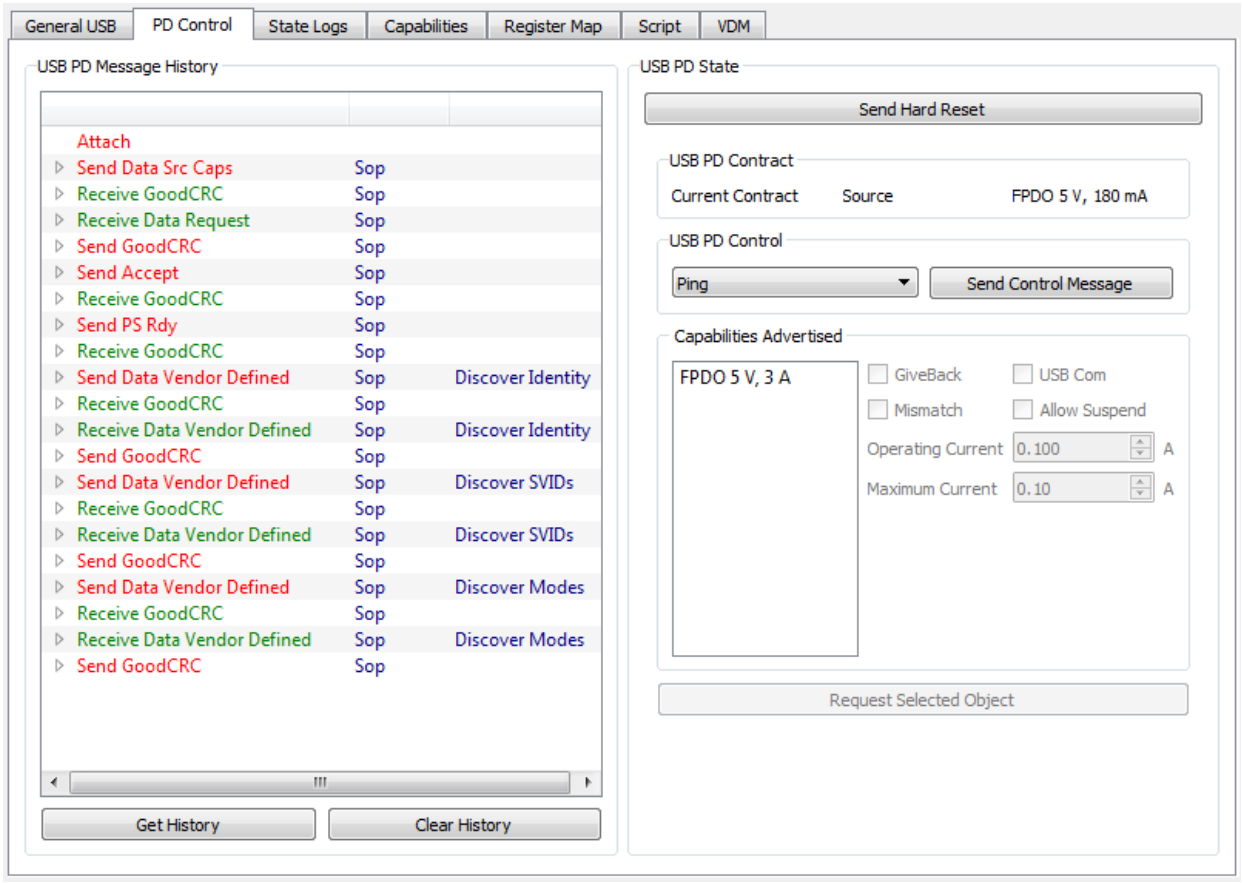


**Figure 6. PD Control Tab**

### State Logs

Events can be logged in the software by checking the “Auto Poll” option in the Preferences menu. These logs can be useful in debugging and in checking the timing of various operations. Each log message has the timestamp (with 100 μs resolution). To stop logging, click the “Auto Poll” option in the Preferences menu.

An example of a Type−C attach and the PD communication flow is shown below.

To support debug efforts, the “Set State” button can be used to force a specific state machine state. The state can be selected in the pull down menu to the left of the “Set State” button.

The screens can be cleared with the “Clear State Log” and “Clear PD State Log” buttons to the right of each window.

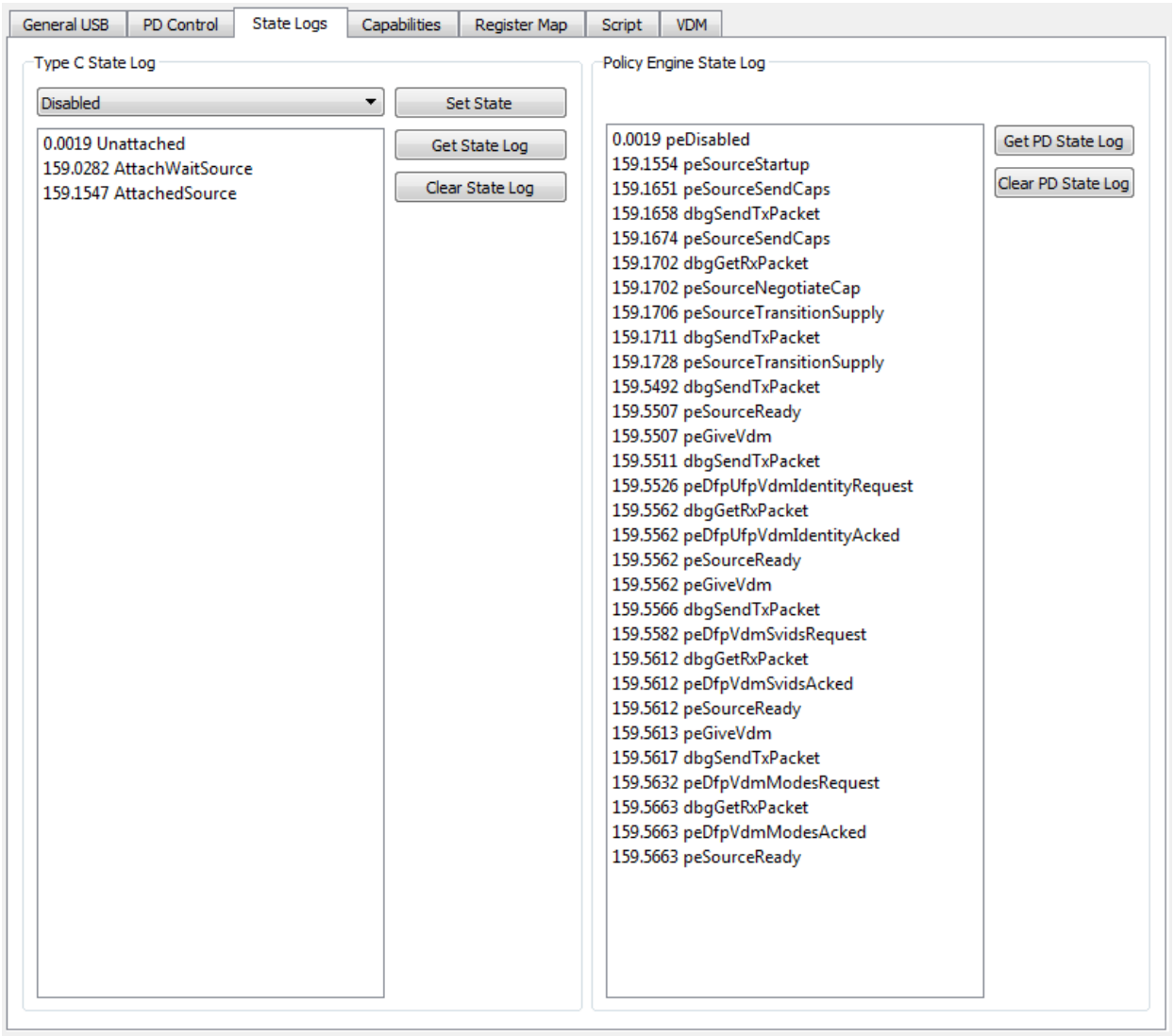


**Figure 7. State Logs Tab**

### Capabilities

The “Capabilities” tab is to set−up PD functionality of the EVB. The settings in this tab dictate how the PD state machine will respond 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 Src Caps”, “Read Sink Caps”, and “Read Settings” buttons need to be clicked to reflect the default settings of the PD state machine.

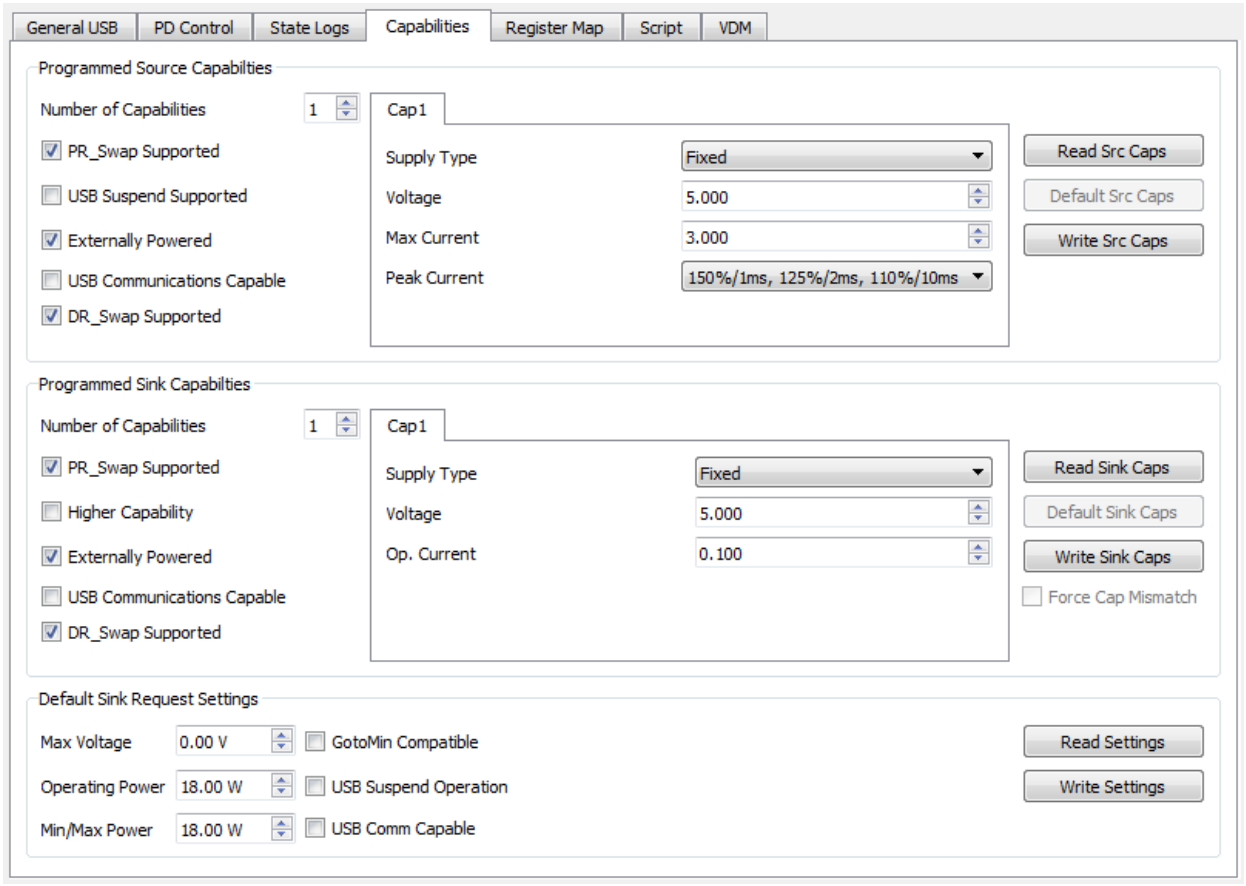


**Figure 8. Capabilities Tab**

### Register Map

The “Register Map” tab enables reading and writing any value to any register in the FUSB302. When performing a register write, the selected register/registers is/are read back again to confirm the write action. So the write button actually performs a write and then a read operation.

The “Device Poll” option tells the GUI to automatically check the DEVICE_ID register for the I2C address selected in the “Addr” pull down box and display the “Device Connected ...” or “ No Device” message in the lower left corner of the GUI.

The “Register Poll” option tells the GUI to constantly poll the FUSB302 registers and update the register values. This should be used only for debugging since it can disrupt the timing operations of the firmware and also can clear interrupts that occur because the FUSB302 interrupt registers are “Read to Clear”.


| Addr | Name | Data(Hex) | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0x01 | DEVICE_ID | A0 | VerID | | | | RevID | | | |
| | | | 1010 | | | | 0000 | | | |
| 0x02 | SWITCHES0 | 03 | PU_EN2 | PU_EN1 | VCONN_... | VCONN_... | MEAS_CC2 | MEAS_CC1 | PDWN | |
| | | | 0 | 0 | 0 | 0 | 0 | 0 | 11 | |
| 0x03 | SWITCHES1 | 20 | POWERR... | SPECREV | | DATAROLE | RESERVED | AUTOCRC | TXCC2 | TXCC1 |
| | | | 0 | 01 | | 0 | 0 | 0 | 0 | 0 |
| 0x04 | MEASURE | 31 | RESERVED | MEAS_V... | MDAC | | | | | |
| | | | 0 | 0 | 110001 | | | | | |
| 0x05 | SLICE | 60 | SDAC_HYS | | SDAC | | | | | |
| | | | 01 | | 100000 | | | | | |
| 0x06 | CONTROL0 | 24 | RESERVED | TX_FLUSH | INT_MASK | LOOPBACK | HOST_CUR | | AUTO_PRE | TX_START |
| | | | 0 | 0 | 1 | 0 | 01 | | 0 | 0 |
| 0x07 | CONTROL1 | 00 | RESERVED | ENSOPDB | | BISTMO... | RESERVED | RX_FLUSH | ENSOP | |
| | | | 0 | 00 | | 0 | 0 | 0 | 00 | |
| 0x08 | CONTROL2 | 02 | TOLG_SAVE_PWR | | TOG_RD... | WAKE_S... | WAKE_EN | MODE | | TOGGLE |
| | | | 00 | | 0 | 0 | 0 | 01 | | 0 |
| 0x09 | CONTROL3 | 06 | RESERVED | SEND_H... | RESERVED | AUTO_H... | AUTO_S... | N_RETRIES | | AUTO_R... |
| | | | 0 | 0 | 0 | 0 | 0 | 11 | | 0 |
| 0x0A | MASK | 00 | M_VBUSOK | M_ACTIV... | M_COMP... | M_CRC_C... | M_ALERT | M_WAKE | M_COLLI... | M_BC_LVL |

**Figure 9. Register Map Tab**

### Script

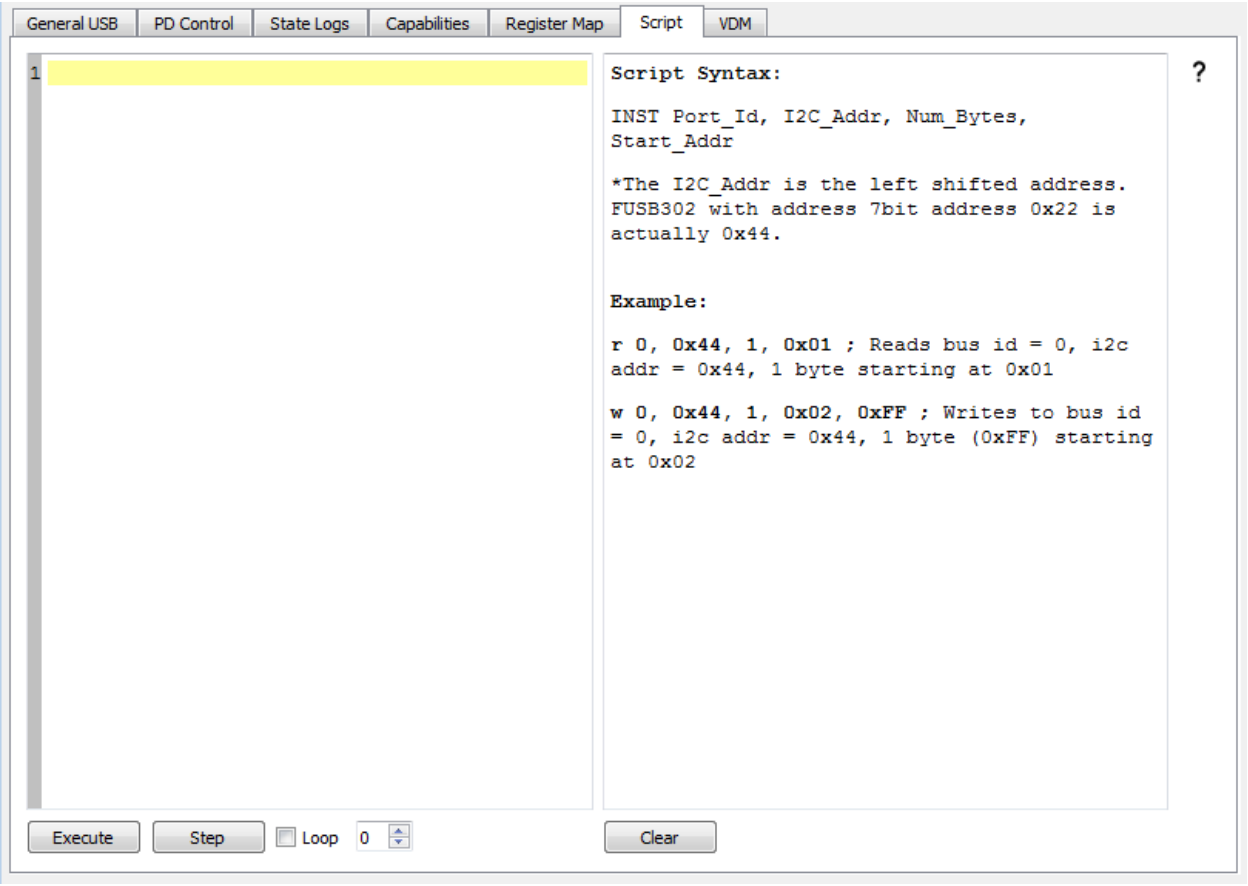


**Figure 10. Script Tab**

The "Script" tab enables the use of scripts to configure the FUSB302. Scripts can be added through the GUI using the editing window on the left of the tab. This edit window allows for normal copying and pasting to or from any text file if you want to save or copy your scripts from external files. Each line of the script should be formatted as follows:

***Command, port, I²C addr, # bytes, register addr, data1, ..., dataN, optional comment***

- The ***Command*** is: "r" or "w"
- The ***port*** is always 0
- The ***I2C addr*** is either 0x44, 0x46, 0x48, or 0x4A
- The ***# bytes*** is the number of bytes to read or write
- The ***register addr*** is the starting register address
- The ***data1, ..., dataN*** are for writing values to registers
- And ***optional comment*** is just informational

Each field can be separated with a space (" "), a comma (","), or a semicolon (";").

An example of reading from 3 consecutive registers:

***r 0 0x42 3 0x04 ; read 3 bytes starting at MEASURE (register address 0x04)***

An example of writing to 2 consecutive registers:

***w 0 0x42 2 0x0E 0x22 0x55 ; write 2 bytes starting at MASKA (register address 0x0E)***

The Execute button will run all the lines of the script.

The Step button will execute the highlighted line.

The Loop feature will loop the entire script up to 99 times. Setting Loop count to 0 will loop indefinitely.

Results of the executed script are shown in the box on the right side of the tab. These results can be copied and pasted to an external file.

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

w,0,0x44,1,0x02,0x44; Switches0(PU_EN1, MEAS_CC1)

w,0,0x44,1,0x03,0x01; Switches1(TXCC1)

w,0,0x44,1,0x04,0x31; MDAC

w,0,0x44,1,0x05,0x20; SDAC

w,0,0x44,1,0x0B,0x0F; Configure Power

w,0,0x44,1,0x06,0x10; Control0(Loopback, clear int mask)

w,0,0x44,1,0x43,0x12; SOP1

w,0,0x44,1,0x43,0x12; SOP1

w,0,0x44,1,0x43,0x12; SOP1

w,0,0x44,1,0x43,0x13; SOP2

w,0,0x44,1,0x43,0x82; PACKSYM with 2 bytes

w,0,0x44,1,0x43,0x01; Data1

w,0,0x44,1,0x43,0x02; Data2
w,0,0x44,1,0x43,0xFF; Jam CRC
w,0,0x44,1,0x43,0x14; EOP
w,0,0x44,1,0x43,0xFE; TXOFF
w,0,0x44,1,0x43,0xA1; TXON

### VDM

The VDM tab supports Vendor Defined Messages (VDM). The “Configuration” section is used for configuring the FUSB302. The upper left “FUSB302” section window is used for displaying and modifying or adding VDM information to the EVB. Right−clicking on the Sop field allows you to add SVIDs. Right clicking on an SVID allows you to remove the SVID or add a Mode. Right−clicking on a Mode allows you to remove it.

Retrieving VDM information from a connected device can be done in the lower left “Other” section window. Right−clicking on Sop allows you to request Discover Identity or Discover SVIDs. Right−clicking on a SVID allows you to request Discover Modes. Right−clicking on a Mode allows you to request to Enter or Exit that Mode.

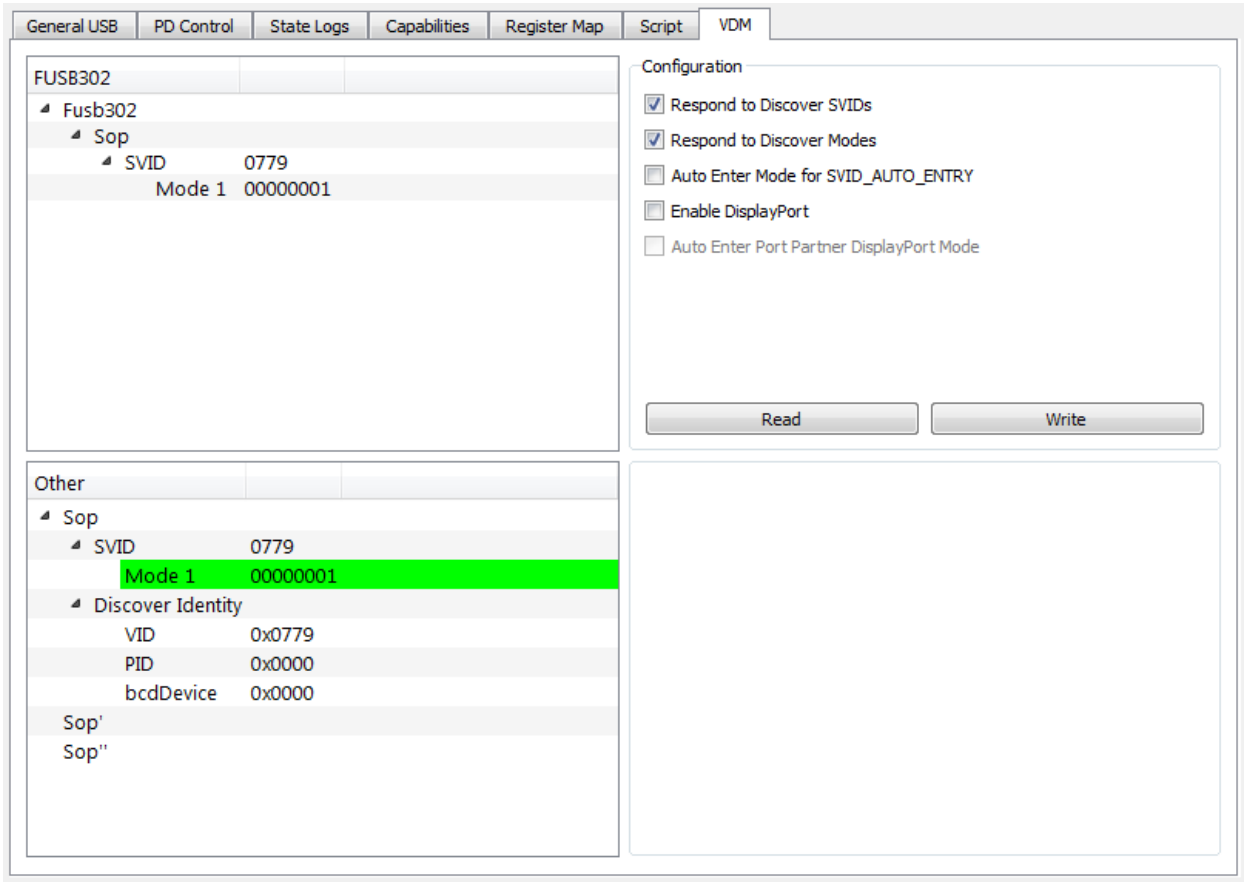


**Figure 11. VDM Tab**

## ADDITIONAL INFORMATION

**TECHNICAL PUBLICATIONS**:
**Technical Library:** www.onsemi.com/design/resources/technical−documentation
**onsemi Website:** www.onsemi.com

**ONLINE SUPPORT**: www.onsemi.com/support
**For additional information, please contact your local Sales Representative at** www.onsemi.com/support/sales