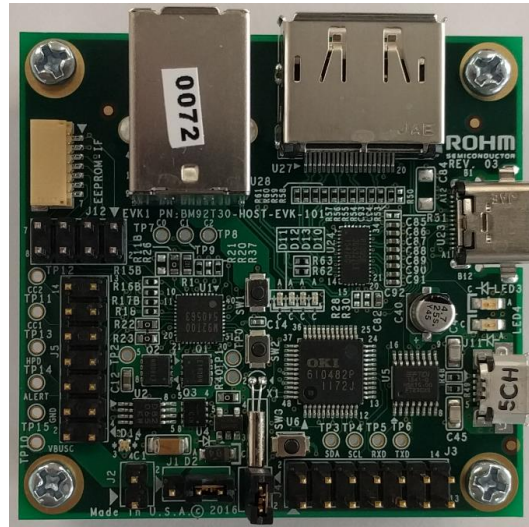
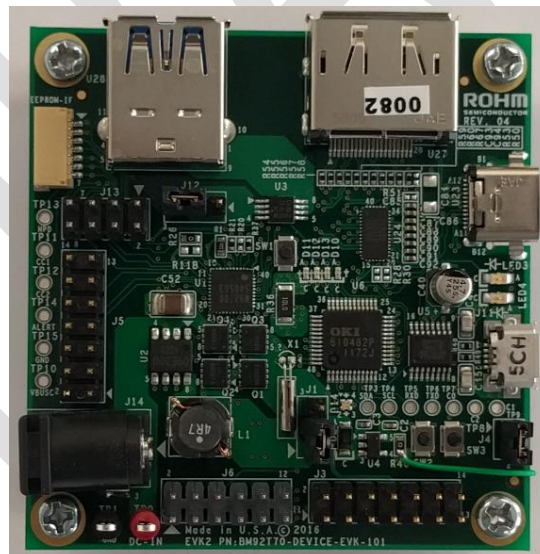


ROHM USB-PD DP Alt Mode EVK Board Manual: BM92T30-HOST-EVK-101 (EVK1) BM92T70-DEVICE-EVK-101 (EVK2)



EVK1: BM92T30MWV based Host/PC Side, HW REV03

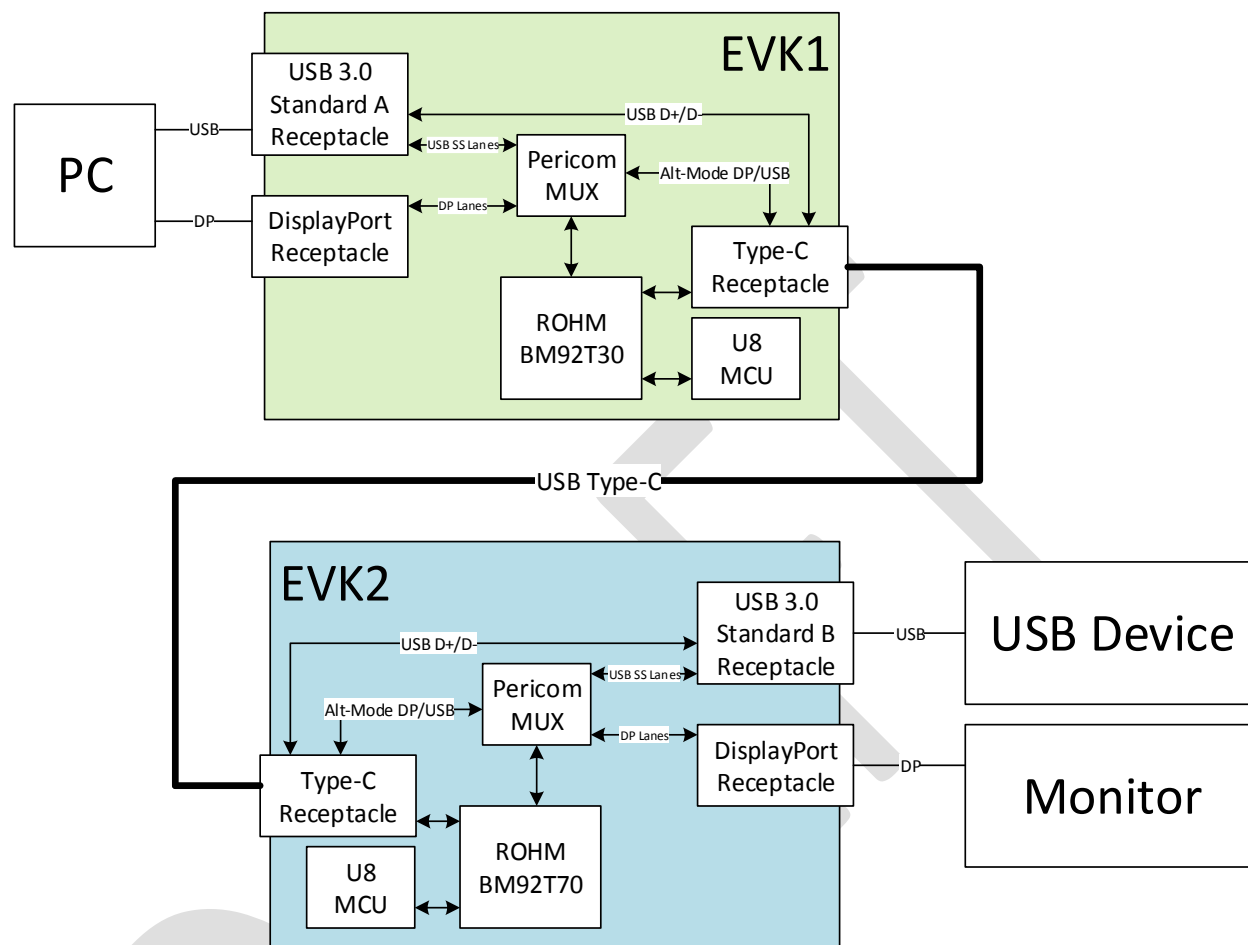


EVK2: BM92T70MWV based Device/Monitor-USB3.0 Side, HW REV04

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Introduction



- As seen in the block diagram above, this EVK setup demonstrates USB-PD Alt Mode DP over the USB type C cable.
- EVK1 shows the “Host” side of the demo. It will connect to a PC through USB-SS 3.0 and DisplayPort (DP) connections.
- EVK2 shows the “Device” side of this demo. It will connect to the host board using a Type-C cable. Depending on the device connected and settings on the board, this will connect the USB 3.0 or DP monitor to the PC setup.

Additional Resources

Video Demonstrations

- BM92T30-HOST-EVK-101
 - <https://youtu.be/YEIDfTC97i4>
- BM92T70-DEVICE-EVK-101
 - <https://youtu.be/2LjfqHi3JEg>

Public Collateral

Please note that some public collateral can be found within the following GitHub public repository:

https://github.com/ROHMUSDC/ROHM_USB-PD_BM92T30-BM92T70-EVK-Demo

Please note that there is additional collateral available outside of the collateral shown in the GitHub repository above. This includes detailed technical notes and EC firmware source code. In order to access this information, please seek an NDA with ROHM by speaking with your ROHM sales manager or by sending an inquiry to engineering@rohmsemiconductor.com

If you have any questions on programming the ECs, please refer to the LAPIS IDEU8 User Manual as well as the FWuEASE User Manual (provided after installing the U8 IDE suite).

General Operation Usage

Materials Required

The following is our recommendation of equipment required to fully test the USB PD Alt Mode EVK1 and EVK2 boards.

EVK1 Side:

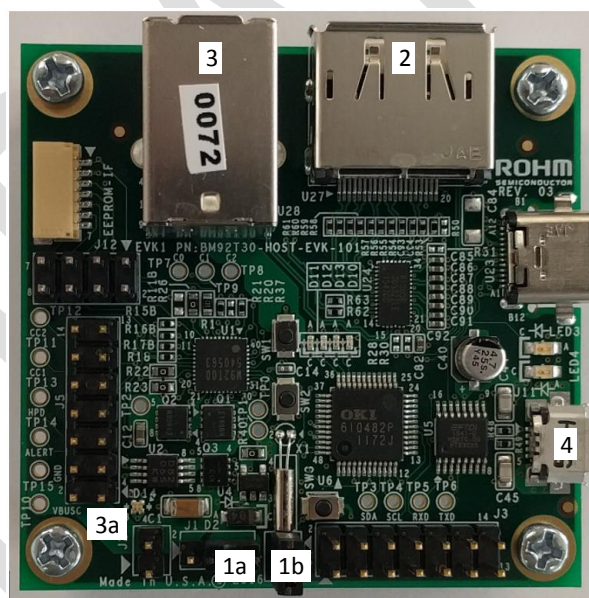
- Host PC that can act as DisplayPort Source and USB3.0 Source
- USB3.0 Standard A to Standard B Cable
 - This will provide the EVK1 board with system power as well as connection to host PC's USB3.0 data port
- DisplayPort Cable
 - This will provide DP source to EVK1 Board
- USB Standard A to micro B Cable
 - Will allow the user to check logs of applicable messages and write I2C commands from the EC to the USB-PD IC
 - This is optional but recommended as it shows the operation and useful messages for operating EVK1
- USB Type-C Cable

- To connect this board to EVK2

EVK2 Side:

- DisplayPort Monitor
 - This will output the Host PC's DisplayPort source signal from the host PC when the mode is applicable
- USB3.0 Device
 - This will connect to the Host PC's USB3.0 port from the host PC when the mode is applicable
- USB Standard A to micro B Cable (To Debug PC)
 - Will allow the user to check logs of applicable messages and write I2C commands from the EC to the USB-PD IC
- Power Supply – 19V Supply
 - Required to power the EVK2 board and also is used to provide power to EVK1 board side if requested

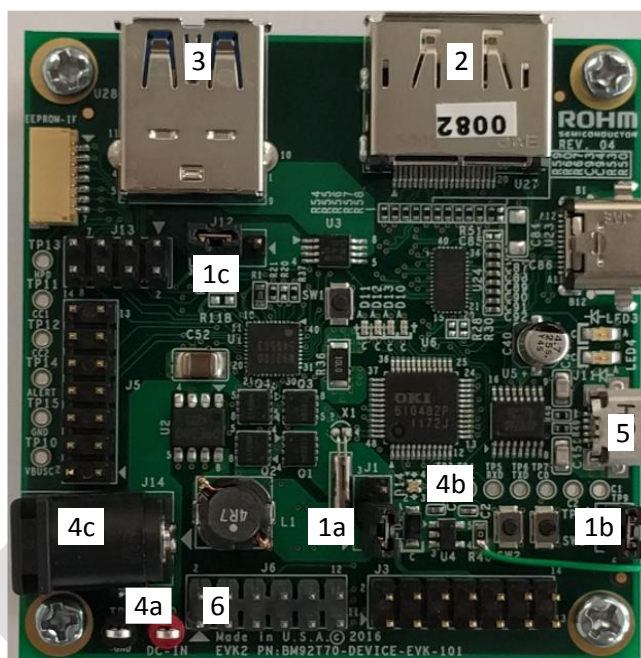
EVK1 Preparation



1. Recommended Jumper Settings:
 - a. J1: Jumped between pins 2+3
 - b. J4: Jumped between pins 1+2
2. Connect the Display Port Cable between DP receptacle (U27) and the PC Display Port source
3. Connect a USB 3.0 Type A Cable between the USB 3.0 Receptacle (U28) and one of the PC's USB 3.0 ports

- a. When power reaches the board, LED indicator (D14) will light up at the bottom left corner of the board
4. (Optional, but Recommended) Connect a micro USB cable between USB receptacle (U11) and a debug PC

EVK2 Preparation



1. Jumper Settings:
 - a. J1: Jumped between pins 1+2
 - b. J4: Jumped between pins 1+2
 - c. J12: Jumped between pins 2+3
2. Connect the Display Port Cable between DP receptacle (U27) and the Display Port Monitor sink
3. Connect a USB 3.0 device into USB 3.0 Receptacle (U28)
4. Connect 19V source to the EVK2 Board through TP0 and TP1
 - a. TP0 = 19Vin, TP1 = GND
 - b. When power reaches the board, LED indicator (D14) will light up at the bottom middle of the board
 - c. Alternately, you can also supply 19V power to the Barrel Connector, J14. Middle Pin is tied to the board voltage (19V) and the shielding is tied to GND.
5. Connect a micro USB cable between USB receptacle (U11) and a debug PC
6. Depending on the mode you want to evaluate, either jump pins 1+2 or pins 3+4

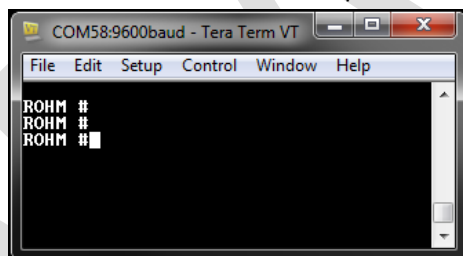
- a. Pins 1+2: Enables 4 Lane DP mode, USB2.0 Mode (No Jumper Default Mode)
- b. Pins 3+4: Enabled 2 Lane DP Mode + USB3.0 SS Mode (2+2 Mode)
 - i. Note: not all PCs can handle this 2+2 mode configuration

DEMO Quick Start

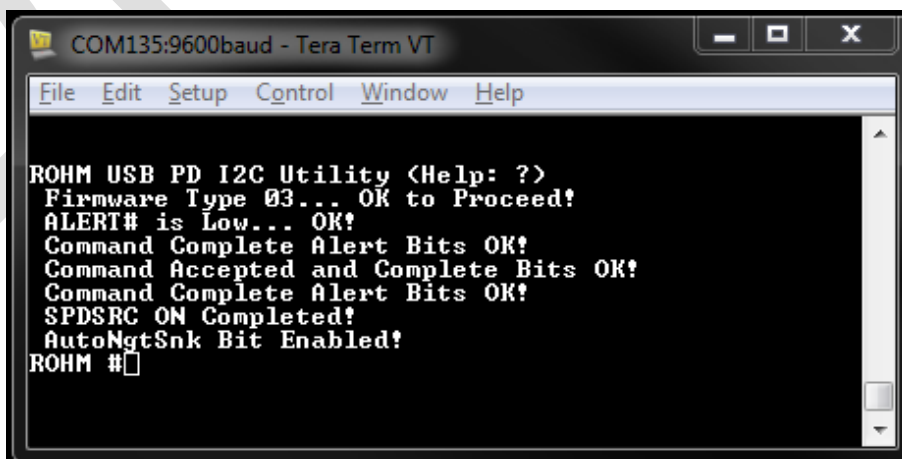
- There are two demos that help show the capabilities of ROHM's USB-PD controller IC when operating with both solutions
 - DisplayPort Monitor Demo – Shows DP video transfer over Type-C
 - USB3.0 Super Speed Connection Demo – Shows USB3.0 data connection over Type-C
- This Document will also show the EVK boards operate on their own with existing devices in the market
 - EVK1 PC Host to Apple MultiPort Dongle and USB3.0 Type-C to USB-A dongle
 - Apple MacBook Host to EVK2 connection to Monitor and USB3.0 device

EVK1 to EVK2 Combined Demo - DisplayPort Monitor Demo Sequence

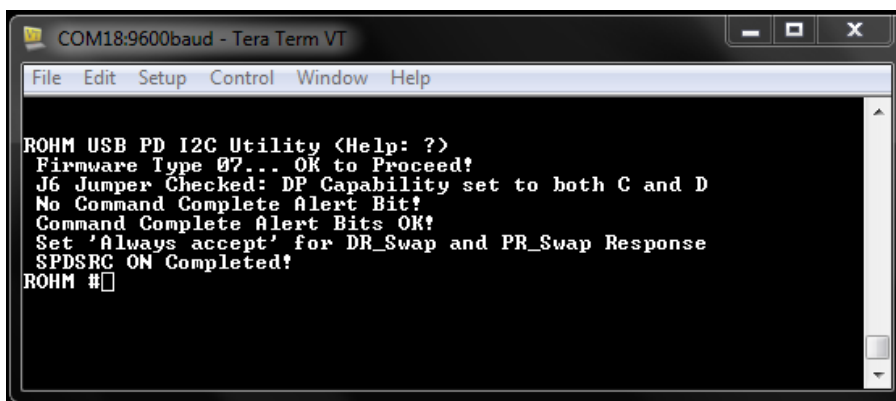
1. Connect the USB Debugging cables to a monitoring PC. Open up the terminals in Tera Term or your preferred COM port viewer to see the return messages.
 - a. Debug terminal will be connected successfully if the user can see the console window and "ROHM#" is seen when enter is pressed.



- i.
 - b. Also, if the reset button is pressed, the COM console will return the following:
 - i. EVK1 Host Side – SW3 RESET



- 1.
 - ii. EVK2 Device Side – SW3 RESET

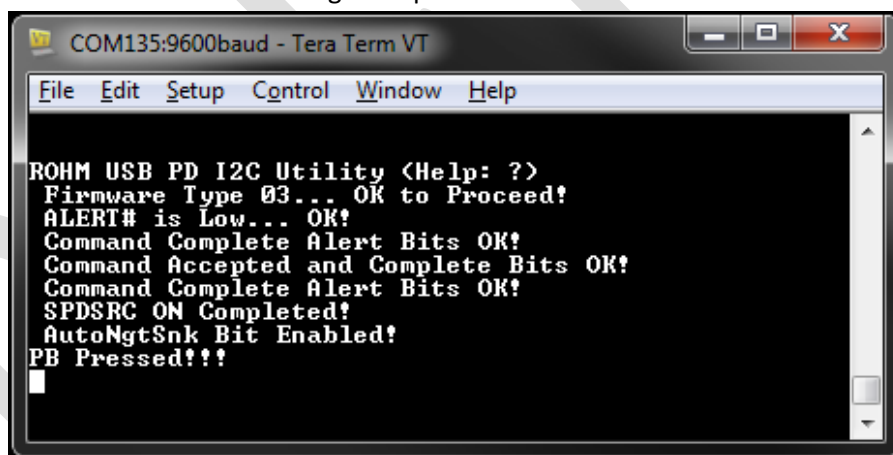


```
COM18:9600baud - Tera Term VT
File Edit Setup Control Window Help
ROHM USB PD I2C Utility <Help: ?>
Firmware Type 07... OK to Proceed!
J6 Jumper Checked: DP Capability set to both C and D
No Command Complete Alert Bit!
Command Complete Alert Bits OK!
Set 'Always accept' for DR_Swap and PR_Swap Response
SPDSRC ON Completed!
ROHM #
```

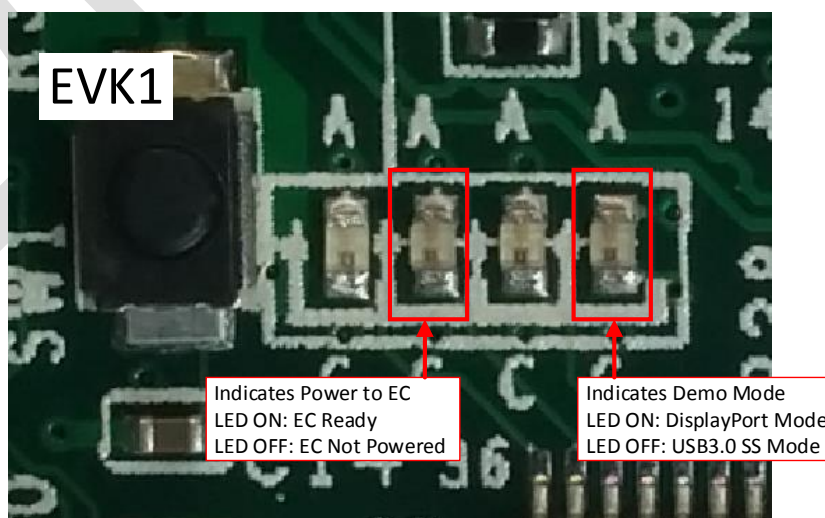
- 1.
2. After the above preparation steps have been completed on each EVK, we can now plug the USB Type-C cable between EVK1 and EVK2.
3. How to Confirm Operation
 - a. Depending on the J6 Jumper setting on EVK2, we can confirm operation in two ways
 - b. Check the PC Display and USB Device connection
 - i. If J6 pin jumper is added between pins 1 and 2, then 4 lanes of Display Port are used over the type C cable and the DisplayPort Monitor should be connected to the PC over the Type-C Cable. Thus, you should see the PC desktop on the DisplayPort Monitor. Also, you should be able to connect to the device USB device (at USB2.0 speeds... no USB3.0 Super Speed lines)
 1. 4 SS Lanes of DisplayPort and USB2.0 Connection
 - ii. If J6 pin jumper is added between pins 3 and 4, then the board is operating in 2 lanes of DisplayPort and 2 lanes of USB3.0 Mode. If this is the case, please be sure that your PC source can accommodate this mode (in my testing, I could not find a 2+2 source) and the display should be shown. Also, the USB device should be connected at USB3.0 full speeds.
 1. 2 SS Lanes of DisplayPort and 2 SS lanes for USB3.0 Connection
 - c. the USB3.0 Device should also be connected to the PC
 - i. Note: this will not be connected as a USB3.0 SS device as only D+/D- are connected and super speed lines are being used for the 4 lanes of DP.
4. Debugging
 - a. Please note that if this doesn't work it is possible that cables connected may not be securely fastened onto the board. Thus, please try re-connecting the appropriate cables for the non-working components (AKA, if DP isn't working, re-connect the DisplayPort cables and/or the Type-C cable between the two EVK boards).
5. Finally, please note that the general console is still available through the UART Debug connectors; thus, please feel free to change, debug, and test registers as required!

EVK1 to EVK2 Combined Demo - USB3.0 Super Speed Device Demo Sequence

1. There is 1 difference to the hardware setup mentioned in the “EVK1 and EVK2 Preparation” sections above.
 - a. We will want to connect the display port monitor directly to the PC and remove the DisplayPort cable from the EVK1 and EVK2 setups. This is because we will be sending USB3.0 super speed signals though the type-C cable and thus, will not be sending the 4 lanes of DisplayPort signals.
2. Follow Step 1 from the DisplayPort Monitor Demo Sequence above to connect the COM ports of these two EVKs properly
3. Once we see the EVK boards connected to the PC, we should press the SW2 pushbutton. This will determine the EVK configuration mode:
 - a. Pressing the SW2 pushbutton will connect the board as a DisplayPort device. The user can double check is this PB was pressed by monitoring any of the following:
 - i. COM console will return the message “PB pressed!!!”



1.
 - ii. OR, LED 4 will be turned off



1.

4. After the above preparation steps have been completed on each EVK, we can now plug the USB Type-C cable between EVK1 and EVK2.
5. How to Confirm Operation
 - a. Upon the Type-C Connection, you should see your USB3.0 device connected to the PC
 - b. Checking the USB3.0 Speed:
 - i. Option 1: Check the “Devices” tab within the control panel.
 1. <http://blogs.msdn.com/b/usbcoreblog/archive/2012/06/27/how-to-determine-whether-a-usb-3-0-device-is-operating-at-superspeed.aspx>
 2. Proper connection will show the USB device connected as a USB3.0 device.
 3. Incorrect connection will show this device as “can work faster if connected to a USB3.0 Port”
 - ii. Option 2: Pickup and use the “usbview.exe” tool provided online or from the GitHub Repository
 1. USB SS Connection: **bcdUSB: 0x0300**

Device Descriptor:
 bcdUSB: 0x0300
 bDeviceClass: 0x00
 bDeviceSubClass: 0x00
 bDeviceProtocol: 0x00
 bMaxPacketSize0: 0x09 (9)
 idVendor: 0x174C
 idProduct: 0x1153
 bcdDevice: 0x0100
 iManufacturer: 0x02
 iProduct: 0x03
 iSerialNumber: 0x01
 bNumConfigurations: 0x01

a.

2. USB Standard Speed Connection: **bcdUSB: 0x210**

Device Descriptor:
 bcdUSB: 0x0210
 bDeviceClass: 0x00
 bDeviceSubClass: 0x00
 bDeviceProtocol: 0x00
 bMaxPacketSize0: 0x40 (64)
 idVendor: 0x174C
 idProduct: 0x1153
 bcdDevice: 0x0100
 iManufacturer: 0x02
 iProduct: 0x03
 iSerialNumber: 0x01
 bNumConfigurations: 0x01

a.

EVK Tested Environments

This EVK has been tested with the following solutions already available in the market:

EVK1: Apple Multiport Dongle (VGA and HDMI), Google Type-C to DP Cable, Nexus 5x (USB-PD Charging only)

EVK2: Apple MacBook with Type-C Connector, Google Chromebook Pixel, Nexus 5x (USB-PD Charging only)

Evaluation for USB-PD BM92T10 and BM92T50 USB-PD Solutions

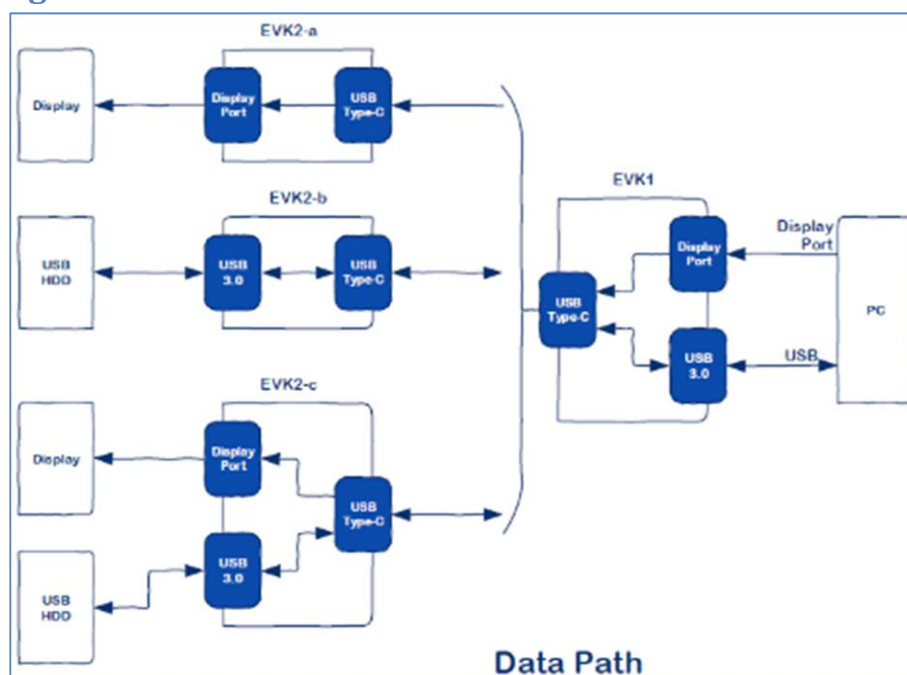
Please note that the BM92T10 can be evaluated using the BM92T30-HOST-EVK-101 Evaluation board.

Similarly, the BM92T50 can be evaluated using the BM92T70-DEVICE-EVK-101 Evaluation board.

The only major differences between T10/T50 and T30/70 is that the T30 and T70 devices support MUX control direct from the USB-PD controller IC. When looking at only the USB-PD negotiation portion of the design, the T10 is equivalent to T30 and T50 is equivalent to T70.

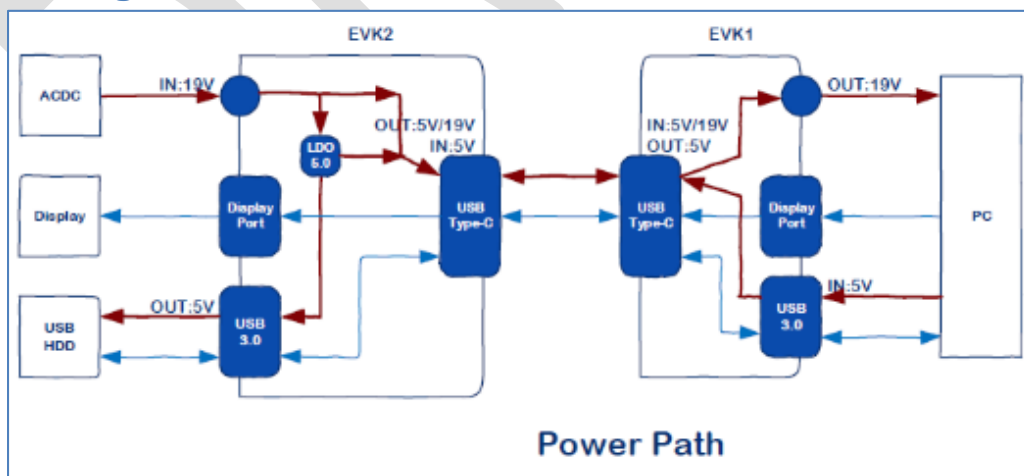
High Level Block Diagram

Data Pathing



The figure above shows the data paths for this evaluation board. Please note that EVK2 are all only one EVK, but the different values (EVK2-x) shows the different configurations that we want to show on our evaluation board. This is configurable using the J6 jumpers.

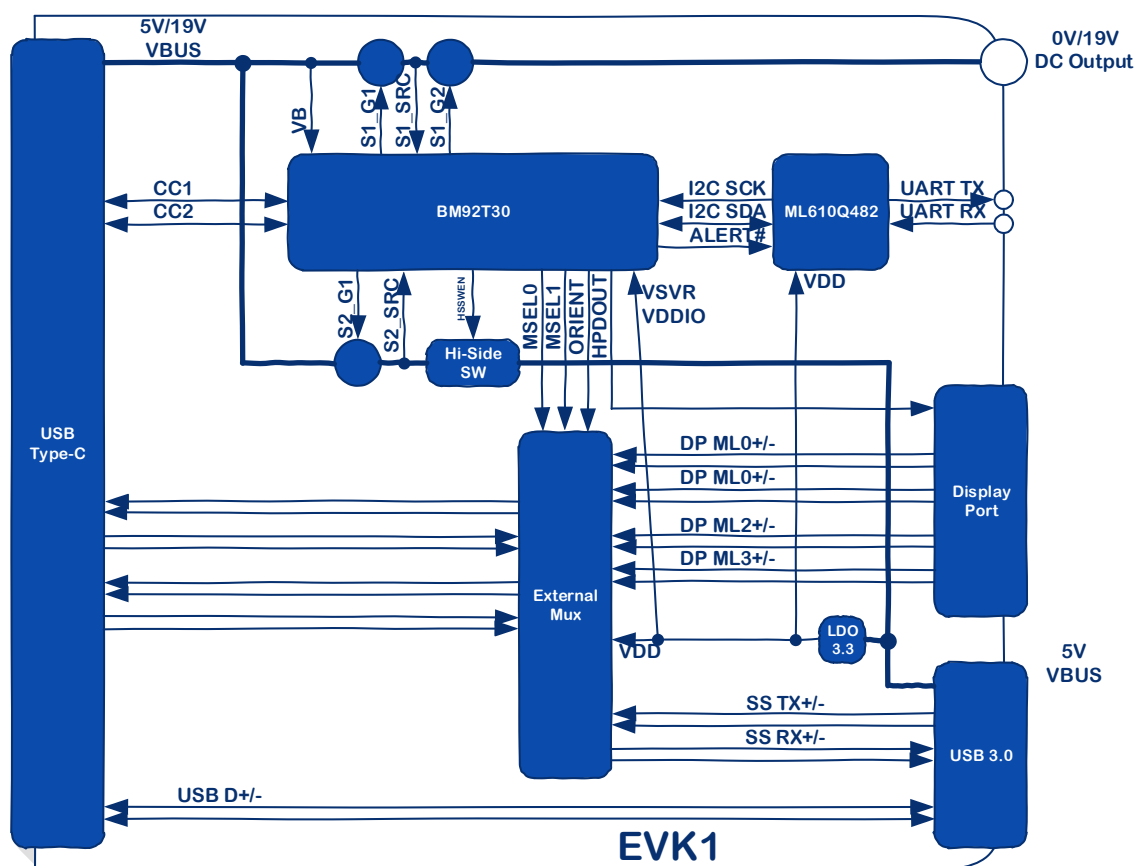
Power Pathing



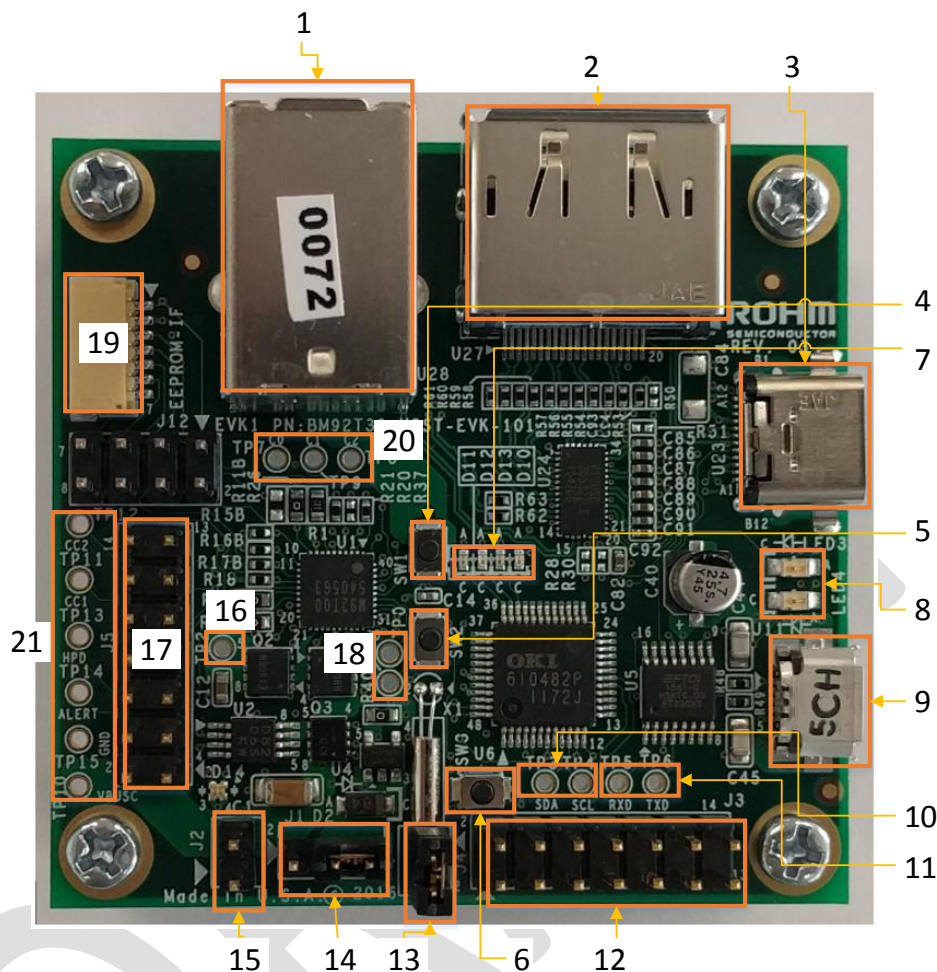
The figure above shows the power path of our evaluation kit. As seen above, EVK1 will be acting as a sink for power obtained from EVK2.

Hardware

EVK1: Block Diagram

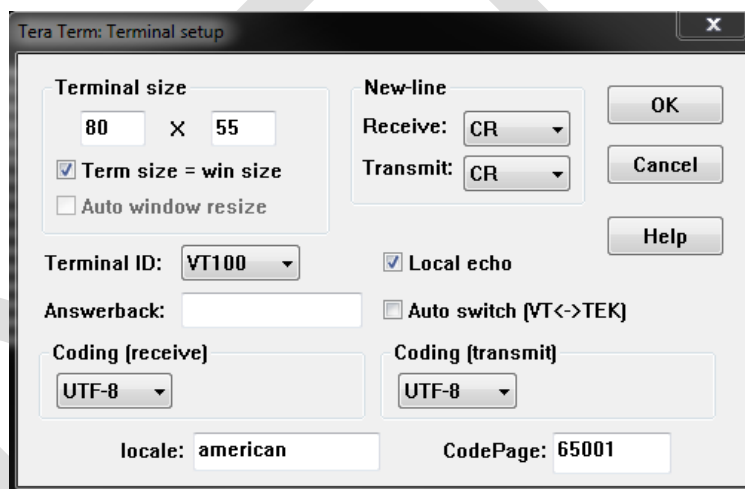


EVK1: Connection Explanation

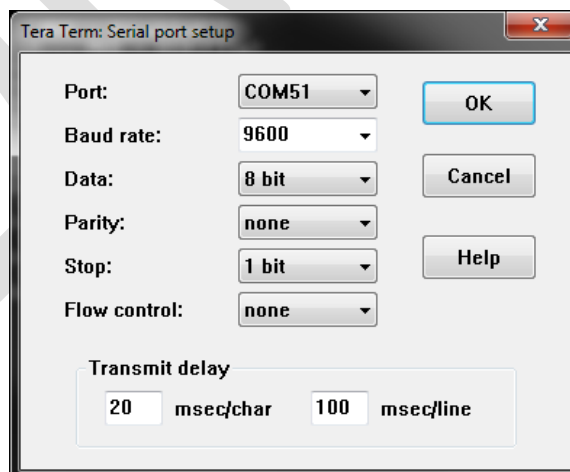


1. U28, USB3.0 A Receptacle
 - Used to connect to the Host PC using a USB 3.0 type A to A male plug cable
2. U27, Display Port Receptacle
 - Used to connect to the Host PC using a Display Port cable
3. U23, USB Type-C Receptacle
 - Used to connect Type-C cable between EVK1 and EVK2
4. SW1, USB-PD IC RESET
 - Used to trigger reset on the XRST pin of the USB-PD device
5. SW2, EC (482) USER PB
 - EC function defined pushbutton
 - Used to switch between USB3.0 only mode and DP Alt Mode
6. SW3, EC (482) IC RESET
 - Used to trigger reset on the RESET_N pin of the EC (482 MCU)

- Note: if no uEASE debugger is attached, then we need to short J4. Alternatively, if the uEASE is attached, then we need to remove the short on J4.
- 7. D10-13, EC (482) User LEDs
 - EC function defined LED output
 - Used to indicate EVK power and USB3.0 or DP mode.
- 8. LED3-4, DEBUG UART Indicator
 - Indicates transmission over the EC's UART debug interface
- 9. J11, Micro-USB Connector, EC (482) Debug Receptacle
 - Connection to the board for the EC's UART debug interface
 - Connect to PC and use any terminal application to open up a COM port
 - In Tera Term, the following settings can be used:
 - Setup -> Terminal



- Setup -> Serial Port



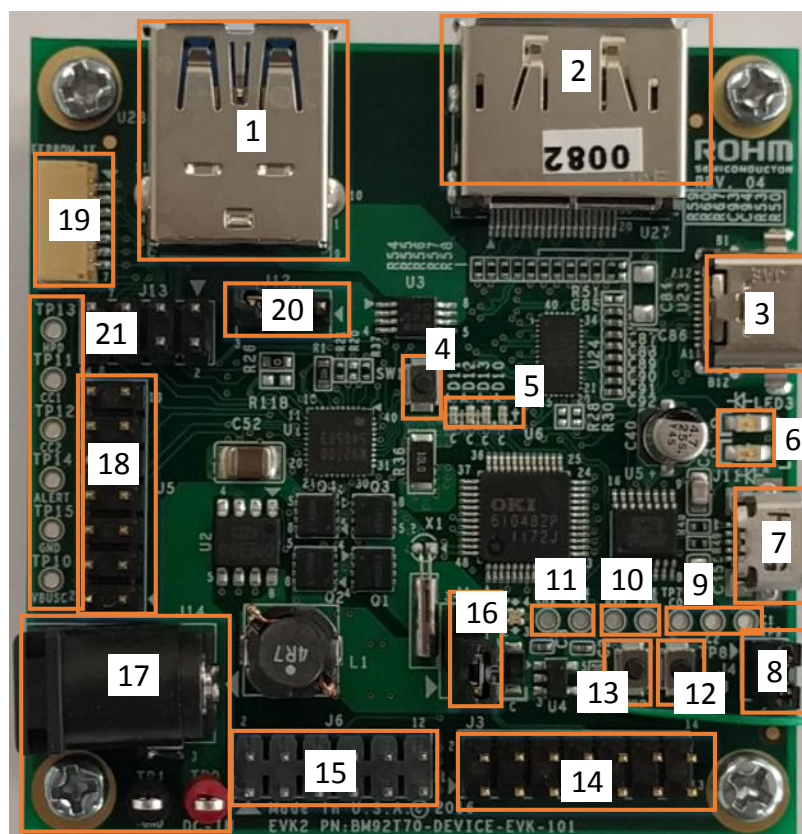
- NOTE: This Evaluation board uses an on board FTDI UART to USB IC for connecting to the host PC. Drivers are usually available immediately on most connected windows

systems, but if you are having driver difficulties, please install the FTDI VCP drivers from the below page:

- <http://www.ftdichip.com/Drivers/VCP.htm>

10. TP3-4, I²C Debug
 - On-board Vias for test pins to debug I²C Communication between EC and USB-PD IC
11. TP5-6, UART Debug
 - On-board Vias for test pins to debug UART communication between EC and UART-to-USB IC
12. J3, EC (482) Programming I/F
 - uEASE Programming Port for the EC (ML610Q482)
 - NOTE: Pin 1 for this header is on the inside of this board! Be sure to connect the uEASE to this board correctly
13. J4, EC Reset Jumper
 - Connected to SW3 EC Reset operation
 - Note: if no uEASE debugger is attached, then we need to short J4. Alternatively, if the uEASE is attached, then we need to remove the short on J4.
14. J1, Power Selector Pins
 - Two Intended Jumper Options
 - Connect Pins 1 and 2: Power will be supplied from the J2 header interface
 - Connect Pins 2 and 3: Power will be supplied from 5V VBUS sourced from the USB3.0 Receptacle
15. J2, External Power Header
 - This header can be used to source power to this board from an external supply. Note, by doing this, we are only providing power to U4, 3.3V LDO. Thus, we lose the 5V connection to VEX using. Thus, we recommend using the USB 3.0 receptacle to source power to this device.
 - External Power Specifications
 - Max Voltage Rating: 5V
 - Pin 1: GND
 - Pin 2: Voltage Input
16. TP2, Charger Power
 - Test/monitor point for the charger power connection
17. J5, USB-PD Debug
 - Secondary programming port for USB-PD IC through DBGMODDT and DBGRSTCK pins
18. TP0-1, XCLP Debug
 - Test/monitor point for the XCLPOFF1 and XCLPOFF2 pins of the USB-PD IC
19. EEPROM-IF, USB-PD IC Programming I/F
 - Primary programming port for the USB-PD IC though the SPI interface

EVK2: Connection Explanation



1. U28, USB3.0 A Receptacle
 - Used to connect to the USB 3.0 device to the system
2. U17, Display Port Receptacle
 - Used to connect to the Display Port Monitor to the system
3. U23, USB Type-C Receptacle
 - Used to connect Type-C cable between EVK1 and EVK2
4. SW1, USB-PD IC RESET
 - Used to trigger reset on the XRST pin of the USB-PD device

5. D10-13, EC (482) User LEDs

- Starting from the SW1 side, the LEDs are arranged into indications LED1/2/3/4
- These Indicate the following:

LEDx	Description	OFF	ON
LED1	EVK2 Power	0	1
LED2	MSEL0	0	1
LED3	MSEL1	0	1
LED4	CC Configure Setting (on T70/EVK side)	0	1

Event	Type-C remove	USB Configured	DP Configured	
MSEL	Disable	USB	PinAssign C, E (4 Lane DP)	PinAssign D, F (2+2 Mode)
LED1	ON	ON	ON	ON
LED2	OFF	ON	ON	ON
LED3	OFF	ON	OFF	ON

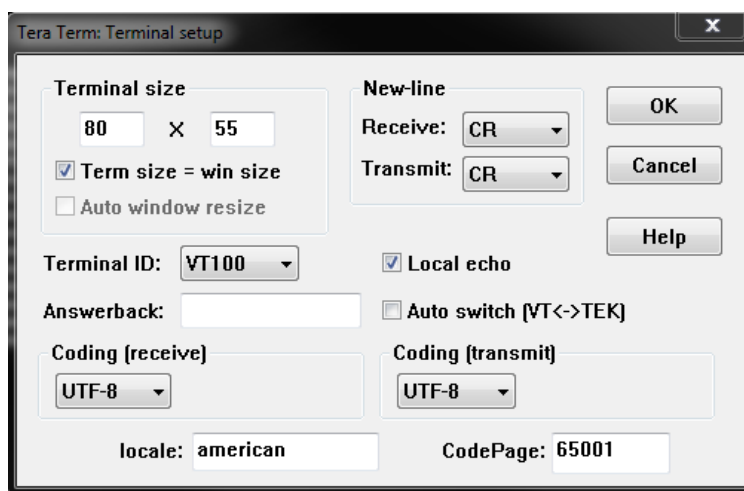
CC Configure Setting	CC1 Used	CC2 Used
LED4	OFF	ON

6. LED3-4, DEBUG UART Indicator

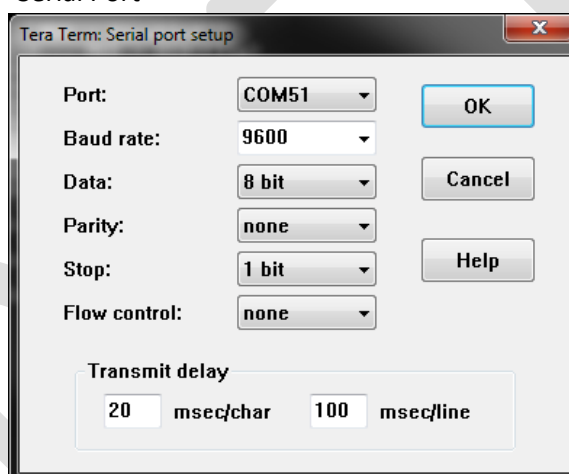
- Indicates transmission over the EC's UART debug interface

7. J11, Micro-USB Connector, EC (482) Debug Receptacle

- Connection to the board for the EC's UART debug interface
- Connect to PC and use any terminal application to open up a COM port
- In Tera Term, the following settings should be used:
 - Setup -> Terminal



- Setup -> Serial Port



- NOTE: This Evaluation board uses an on board FTDI UART to USB IC for connecting to the host PC. Drivers are usually available immediately on most connected windows systems, but if you are having driver difficulties, please install the FTDI VCP drivers from the below page:

- <http://www.ftdichip.com/Drivers/VCP.htm>

8. J4, EC Reset Jumper

- Connected to SW3 EC Reset operation
- Note: if no uEASE debugger is attached, then we need to short J4. Alternatively, if the uEASE is attached, then we need to remove the short on J4.

9. TP7-9, Debug MUX GPIO

- Test/monitor points for the GPIO pins connected to the USB/DP MUX

10. TP5-6, UART Debug

- On-board Vias for test pins to debug UART communication between EC and UART-to-USB IC

11. TP3-4, I²C Debug
 - On-board Vias for test pins to debug I²C Communication between EC and USB-PD IC
12. SW3, EC (482) IC RESET
 - Used to trigger reset on the RESET_N pin of the EC (482 MCU)
 - Note: if no uEASE debugger is attached, then we need to short J4. Alternatively, if the uEASE is attached, then we need to remove the short on J4.
13. SW2, EC (482) USER PB
 - EC function defined pushbutton
14. J3, EC (482) Programming I/F
 - uEASE Programming Port for the EC (ML610Q482)
 - NOTE: Pin 1 for this header is on the inside of this board! Be sure to connect the uEASE to this board correctly
15. J6, User Input Control Header
 - EC Function defined general purpose input control
 - Short Pins 1-2: Pin Assignment C (AKA, 4 Lane DP Mode, USB2.0 Only)
 - Short Pins 3-4: Pin Assignment D (AKA, 2 Lane DP Mode, 2 Lane USB3.0 Mode)
16. J1, Power Selector Pins
 - Two Intended Jumper Options
 - Connect Pins 1 and 2: Power will be supplied from 5V_VSVR (5V SMPS output voltage stepped down from the 19V input)
 - Connect Pins 2 and 3: Power will be supplied from 5V VBUS sourced from the USB Type C Receptacle
17. TP0-1, 19V input voltage terminal and barrel connector for VEX
 - This header is used to supply 19V to VEX. This 19V supply will also be bucked down to 5V to supply VSVR. If J1 is jumped between pins 1 and 2, 3.3V LDO will also be sourced by this 5V SMPS output.
 - In addition to the power header, a barrel connector can also be used to power this IC. The barrel connector's middle pin is connected to VEX and the barrel connector's shield will be tied to GND.
 - External Power Specifications
 - Max Voltage Rating: 19V
 - TP0: Voltage Input
 - TP1: GND
18. J5, USB-PD Debug
 - Secondary programming port for USB-PD IC through DBGMODDT and DBGRSTCK pins
19. EEPROM-IF, USB-PD IC Programming I/F
 - Primary programming port for the USB-PD IC though the SPI interface
20. J12, USB3 VBUS Source Jumper

- Two Intended Jumper Options
 - Connect Pins 1 and 2: 5V power will be supplied to the HSS input using the VBUS from Type-C Receptacle
 - Connect Pins 2 and 3: 5V power will be supplied to the HSS input using the output of 5V_VSVR (5V SMPS output voltage stepped down from the 19V input)

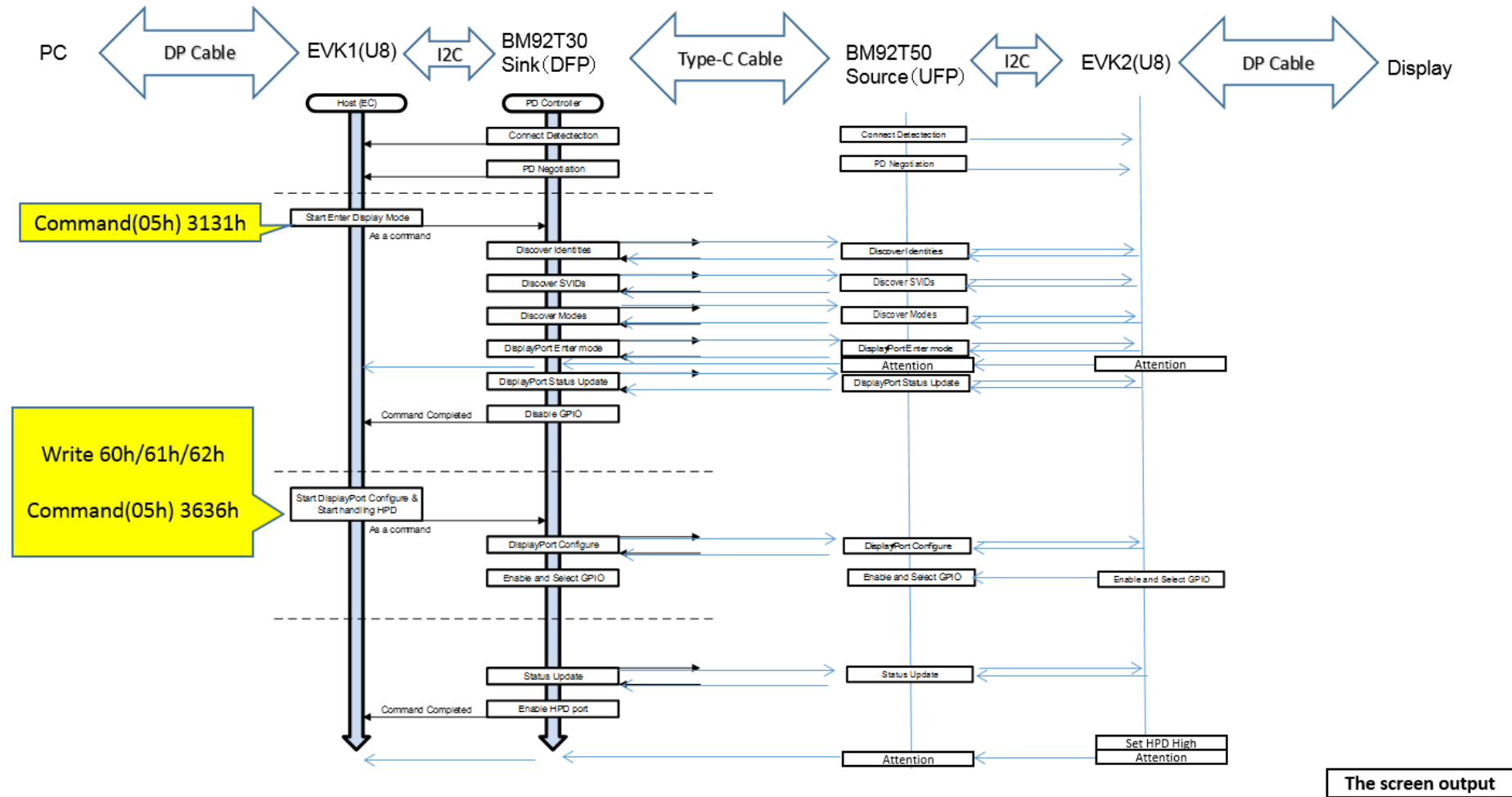
21. TP10-15, General USB-PD Debugging Test Points

- TP10 = Type-C V_{BUS} Net
- TP11 = Type-C CC1 Net
- TP12 = Type-C CC2 Net
- TP13 = DP HPD Net
- TP14 = BM92T70 Alert# Net
- TP15 = GND



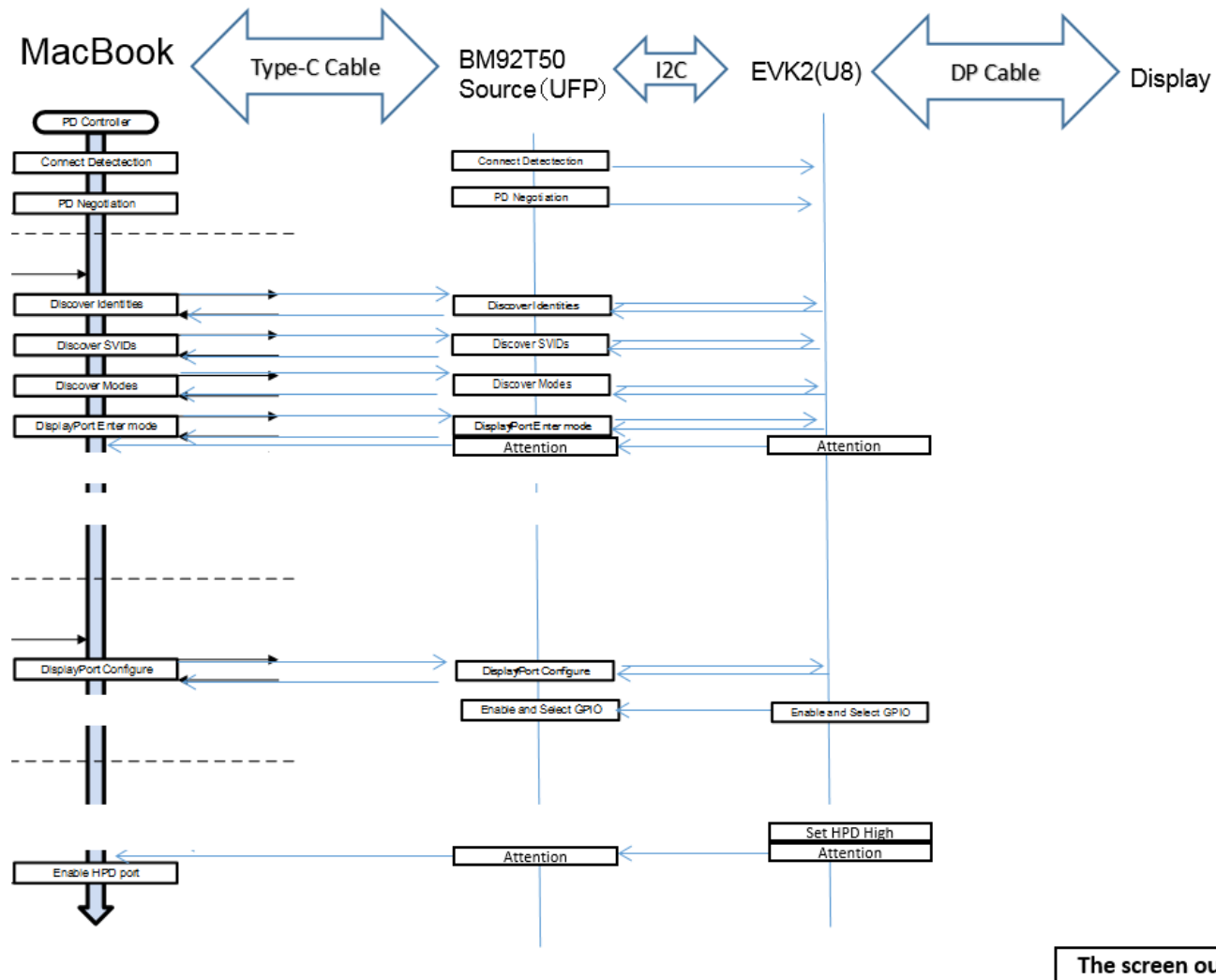
Firmware Explanation

Base Sequence 1 (PC - EVK1 - EVK2 [T50] - Display)



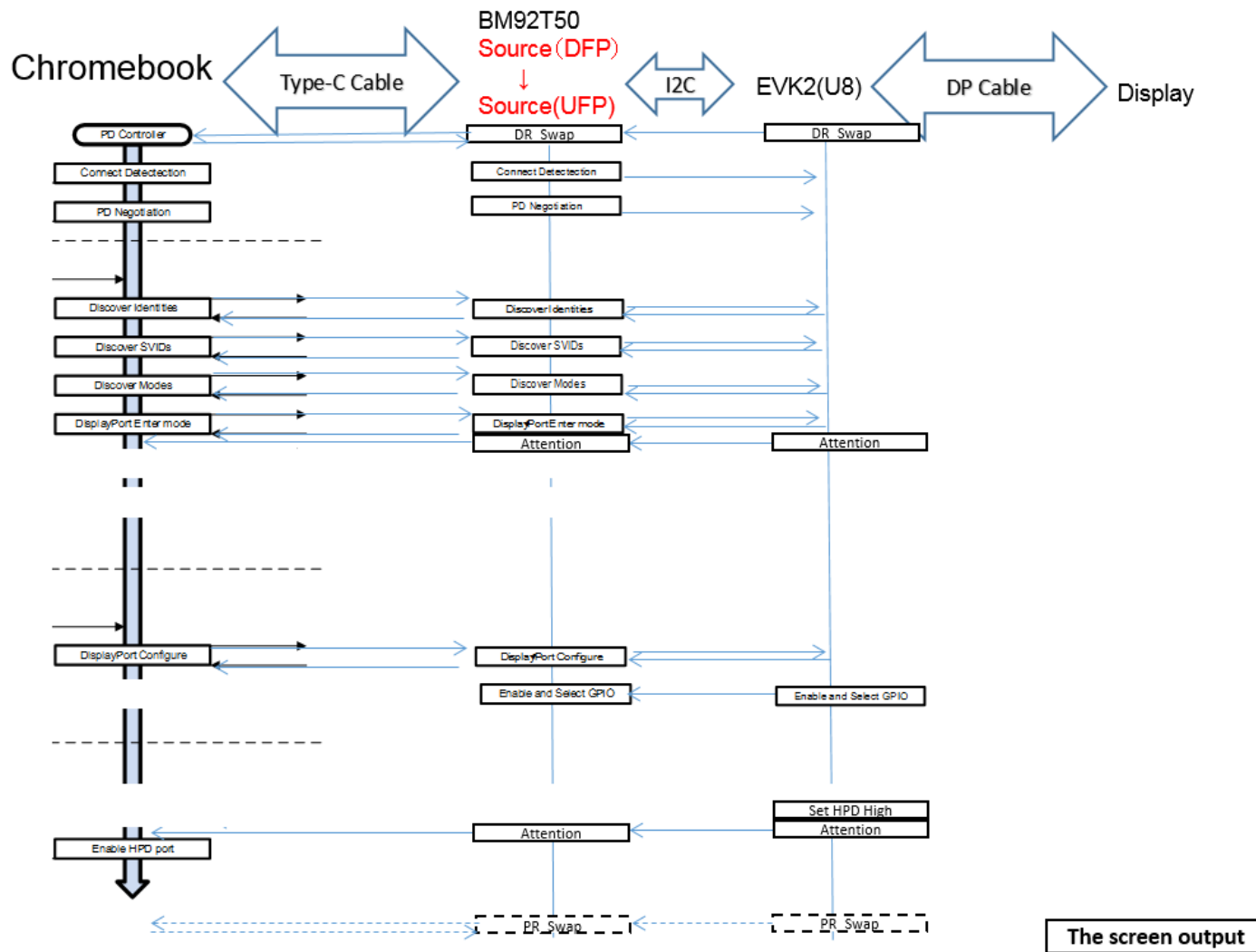


Base Sequence 2 (MacBook - EVK2 [T50] - Display)





Base Sequence 3 (Chromebook - EVK2 [T50] - Display)





Base Sequence 4 (MacBook - EVK2 [T70] - Display)

