UART Operation Manual
For DPIQ Bias Controller

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Using UART Commands through Matlab or GUI

1. PC Driver for the USB-UART Converter

To use USB-UART Converter properly on your computer, essential drivers must be installed properly. You can download from the following links.

For PL2303 Module:

Driver download address:

http://www.waveshare.net/w/upload/6/64/PL2303_Windows_Driver.7z

Other information:

http://www.waveshare.net/wiki/PL2303-USB-UART-Board_Software

For FT232 Module:

Driver download address (32bit windows):

http://www.waveshare.net/w/upload/1/1f/FT232_Driver.7z

Driver download address (64bit windows):

http://www.waveshare.net/w/upload/4/49/CDM_v2.12.06_WHQL_Certified.zip

Other information:

http://www.waveshare.net/w/upload/d/d0/FT232-USB-UART-Board-UserManual.pdf

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2. Connection

This blue unit, which is USB-UART Converter, transforms between USB and UART(TTL232). Connect it with your PC through USB. It will translate the USB data into UART(TTL232) form, which will be understood by bias controller.

GND: ground
TXD: transmit
RXD: receive
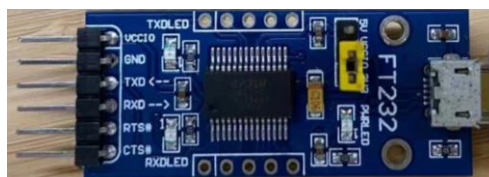
TXD of this blue unit shall be connected with the RX of bias controller.
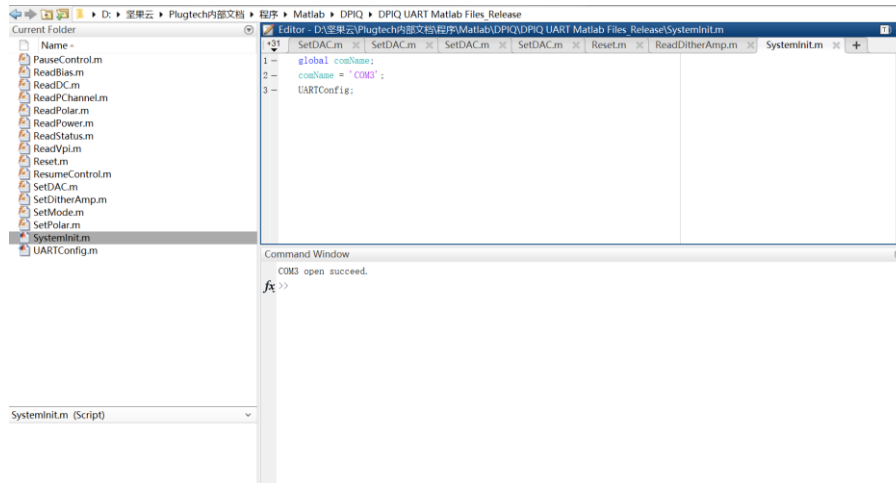RXD of this blue unit shall be connected with the TX of bias controller.
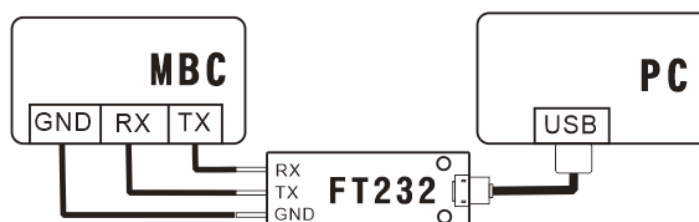
3. Command Execution

3.1 Execute commands through Matlab Script

A. Run SystemInit

a. Firstly, change Matlab working directory to Matlab Script files. Then, you will find several functions available at the left navigation bar.

b. Open SystemInit.m file, change comName to the com port name that the USB-UART Converter installed on your computer. You can check the COM port number in device manager if you are using Windows. In this case, we use COM3.

c. Run SystemInit, if "COM3 opened succeed" is returned, then proceed to the next operation, otherwise, please check whether the COM setting is correct.

B. Run Function Command (SetMode Command for example)

Enter "SetMode (1)" in the command window and run it. If return value is 17 in decimal, the bias controller will enter auto-tracking mode.

Note: SetMode (1): Enter auto-tracking mode; SetMode (2): Enter manual control mode.
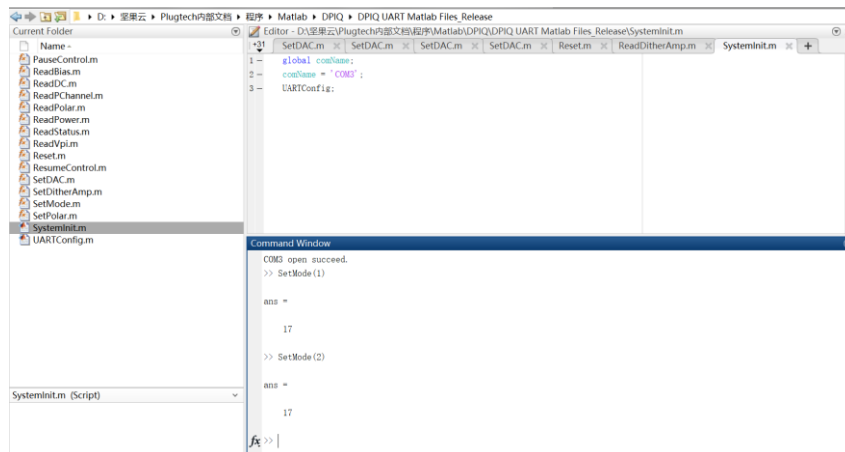
Matlab Script files are described as follows:

1.ReadBias.m

Function: ReadBias (Arm)[1]
Description: Read bias voltage of specific arm.
Value Sent: Arm (1: arm YI; 2: arm YQ; 3: arm YP; 4: arm XI; 5: arm XQ; 6: arm XP).
Value Received: Bias voltage of specific arm. Unit: V.

2.ReadVpi.m

Function: ReadVpi (Arm)[1]
Description: Read V_π of modulator's specific arm.
Value Sent: Arm (1: arm YI; 2: arm YQ; 3: arm YP; 4: arm XI; 5: arm XQ; 6: arm XP).
Value Received: V_π of the modulator's specific arm. Unit: V.

3.ReadPolar.m

Function: ReadPolar[1]
Description: Read polar of bias controller.
Value Sent: NA.
Value Received: Polar setting of bias controller.

4.ReadPower.m

Function: ReadPower
Description: Read back the current optical power received by bias controller.
Value Sent: NA.
Value Received: Current feedback optical power. Unit: μW.

5.ReadStatus.m

Function: ReadStatus
Description: Get current operating status of bias controller.
Value Sent: NA.
Value Received: Current operating status.

6.SetMode.m

Function: SetMode (Mode)[1]
Description: Set control mode of the bias controller to auto-tracking mode or manual control mode.
Value Sent: Mode (1: Auto-tracking mode; 2: Manual control mode).
Value Received: ans=17 (Succeed); ans=136 (Failed).
Note: Bias controller will be reset to auto mode after reset or reboot.

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[1] This command can only be used when bias controller is stabilized (LED constantly ON).

7.SetDitherAmp.m

Function: SetDitherAmp (DitherAmpYI, DitherAmpYQ, DitherAmpXI, DitherAmpXQ)[1]
Description: Set dither amplitude at modulator's specific arm.
Value Sent: DitherAmpYI, DitherAmpYQ, DitherAmpXI, DitherAmpXQ (It can only be the multiple of $1\%V_\pi$ and maximum dither amplitude is 20%. For example, if DitherAmpYI is set to 3. Then dither amplitude on arm YI will be 3%.**).**
Value Received: ans=17 (Succeed); ans=136 (Failed).
Note: DitherAmpYI, DitherAmpYQ, DitherAmpXI and DitherAmpXQ are set to 1 in factory default, when user set a new value to the controller, it will be stored in Flash memory and automatically loaded when the controller is turned on or reset.

8.PauseControl.m

Function: PauseControl[1]
Description: Pause the bias controller's auto-tracking program.
Value Sent: NA.
Value Received: ans=17 (Succeed); ans=136 (Failed).

9.ResumeControl.m

Function: ResumeControl[1]
Description: Resume the bias controller's auto-tracking program.
Value Sent: NA.
Value Received: ans=17 (Succeed); ans=136 (Failed).

10.SetDAC.m

Function: SetDAC (Arm, Voltage)[1]
Description: Set output voltage at modulator specific arm.
Value Sent: Arm (1: arm YI; 2: arm YQ; 3: arm YP; 4: arm XI; 5: arm XQ; 6: arm XP). **Voltage** (Desired output voltage. Accuracy: 0.001V).
Value Received: ans=17 (Succeed); ans=136 (Failed).
Note: This function should be only used when the bias controller is at manual control mode.

11.SetPolar.m

Function: SetPolar (PolarYI, PolarYQ, PolarYP, PolarXI, PolarXQ, PolarXP)
Description: Set polar of bias controller.
Value Sent: PolarYI (1: Positive; 2: Negative).   **PolarXI** (1: Positive; 2: Negative). **PolarYQ** (1: Positive; 2: Negative).   **PolarXQ** (1: Positive; 2: Negative). **PolarYP** (1: Positive; 2: Negative).   **PolarXP** (1: Positive; 2: Negative).
Value Received: ans=17 (Succeed); ans=136 (Failed).

[1] This command can only be used when bias controller is stabilized (LED constantly ON).

12.Reset.m

Function: Reset
Description: Reset the bias controller. It will start from initialization.
Value Sent: NA.
Value Received: NA.

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[1] This command can only be used when bias controller is stabilized (LED constantly ON).

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3.2 Execute commands through GUI

A. Condition

    a. GUI software is developed for Windows OS.

    b. Microsoft .NET Framework 3.5 is required for GUI software. It can be downloaded at following links.

       https://www.microsoft.com/en-us/download/details.aspx?id=21

B. Run GUI Software

    a. Connect bias controller and PC according to Connection Section above, and then turn on bias controller.

   b. Run DPIQ Control Unit.exe or PlugTech MBC Control Unit.exe.

    c. Select com port that the USB-UART Converter installed on your computer, then click Launch button to enter control platform. COM port can be detected automatically if USB-UART driver installed properly. COM port number can be found in Windows device manager.
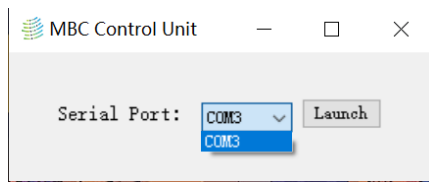
C. Run Function Command (ReadStatus Command for example)

    a. Click "Read Status" button.

    b. Check the result in the Response of MBC Region.
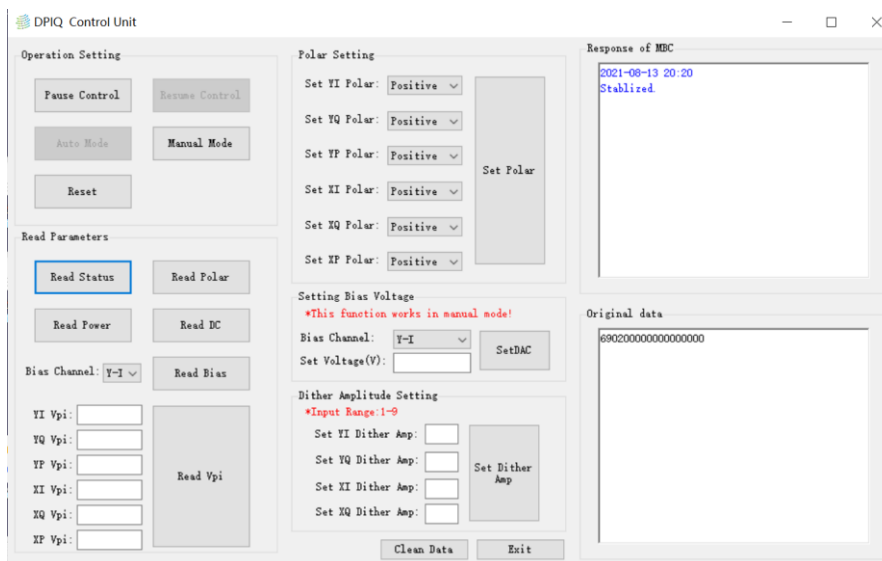
GUI functions are described as follows:

● **Pause Control[1]:**

This function will pause the bias controller's auto-tracking program. Dither will be stopped and bias voltage output of arm YI, YQ, YP, XI, XQ and XP will remain at the value when the Pause Control command is executed.

● **Resume Control[1]:**

When pause control is executed and the auto-tracking program is needed, execute this command will resume auto-tracking program.

● **Manual Mode[1]:**

This function will stop the auto-tracking program. Dither will be stopped and bias voltage output of arm YI, YQ, YP, XI, XQ and XP will remain at the value when the Manual Mode command is executed. User can manually change the bias voltage.

● **Auto Mode[1]:**

When Manual Mode is executed and the auto-tracking mode is needed, execute this command will recalculate the control parameters and start auto-tracking.

● **Reset:**

Reset the bias controller. It will start from initialization.

● **Read Status:**

Read current operation status of bias controller.

● **Read Polar[1]:**

Read current polar of bias controller.

● **Read Power:**

Read back the current optical power received by bias controller (unit: uW).

● **Read Bias[1]:**

Read current bias voltage of specific arm (unit: V).

● **Read Vpi[1]:**

Read V_{π} value of modulator (unit: V).

● **Polar Setting:**

Change the polar setting of bias controller.

● **Setting Bias Voltage[1]:**

Change the output voltage in manual control mode.

● **Dither Amplitude Setting[1]:**

Set dither amplitude on arm YI, YQ, XI and XQ. It can only be the multiple of $1\%V_{\pi}$.

For example, if YI Dither Amp is set to 3. Then dither amplitude on arm YI will be 3%.

Note: YI Dither Amp, YQ Dither Amp, XI Dither Amp and XQ Dither Amp are set to 1 in factory default, when user set a new value to the controller, it will be stored in Flash memory and automatically loaded when the controller is turned on or reset.

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[1] This command can only be used when bias controller is stabilized (LED constantly ON).

Using UART Commands through master device

1. Configuration

The UART of the bias controller works at TTL (3.3V) level with following parameters: 57600 baud rate; 8 data bits, no parity bit, 1 stop bit.

2. Communication Protocol

A. Send command to bias controller

All command send to controller should follow a pattern of command ID + data. Command ID is one byte long which represents the function to be called by controller while data is six bytes long. For data bytes, it should be filled from the first byte and all unused bytes should be filled with zero. For example, to call command ID 0x64 with input data 2000 in hexadecimal format, [0x64,0x07,0xD0,0x00,0x00,0x00,0x00] should be sent to controller. Where 0x64 is the function ID and [0x07,0xD0] is 2000 in hexadecimal format.

B. Receive data from bias controller

After executing command from master device, controller will return data (except for reset command). Received data also follow a pattern of command ID + data. Command ID is one byte long representing the previous ID sent to controller and data is eight bytes long representing returned data from controller. Returned data is filled from the first byte and unused bytes are filled with zero. For example, if [0x64,0x11,0x00,0x00,0x00,0x00,0x00,0x00,0x00] is received by master device, command ID is 0x64, data is 0x11.

3. UART Command List

ReadPolar[1]	
Command ID	0x68
Description	Read polar of bias controller.
Data Send	NA
Data Received	Polar of bias controller. (Byte one: polar of Arm YI; Byte two: polar of Arm YQ; Byte three: polar of Arm YP; Byte four: polar of Arm XI; Byte five: polar of Arm XQ; Byte six: polar of Arm XP. 0x00 for positive; 0x01 for negative.)
	Data byte length: 6.
Example	Send content (Hexadecimal): 68 00 00 00 00 00 00
	Received content (Hexadecimal): 68 00 01 00 00 01 00 00 00

Received content (Hexadecimal): 68 00 01 00 00 01 00 00 00

Arm YI: Positive
Arm YQ: Negative
Arm YP: Positive
Arm XI: Positive
Arm XQ: Negative
Arm XP: Positive

[1] This command can only be used when bias controller is stabilized (LED constantly ON).

ReadBias[1]

Command ID	0x66
Description	Read bias voltage of specific arm.
Data Send	**Arm.** (0x01: Arm YI; 0x02: Arm YQ; 0x03: Arm YP; 0x04: Arm XI; 0x05: Arm XQ; 0x06: Arm XP)
	Data byte length: 1.
Data Received	4 byte floating point number (Little Endian). Unit: V.
	Data byte length: 4.
Example	Send content (Hexadecimal): 66 01 00 00 00 00 00
	Received content (Hexadecimal): 66 22 F5 1F 41 88 00 00 00	The output voltage of arm YI is 10V.

ReadPower

Command ID	0x65
Description	Read back the current optical power received by bias controller.
Data Send	NA
Data Received	4 byte floating point number (Little Endian). Unit: uW.
	Data byte length: 4.
Example	Send content (Hexadecimal): 65 00 00 00 00 00 00
Example	Received content (Hexadecimal): 65 22 F5 1F 41 00 00 00 00	The optical power is 10uW.

ReadVpi[1]

Command ID	0x67
Description	Read V_π of specific arm.
Data Send	**Arm.** (0x01: Arm YI; 0x02: Arm YQ; 0x03: Arm YP; 0x04: Arm XI; 0x05: Arm XQ; 0x06: Arm XP)
	Data byte length: 1.
Data Received	4 byte floating point number (Little Endian). Unit: V.
	Data byte length: 4.
Example	Send content (Hexadecimal): 67 01 00 00 00 00 00
	Received content (Hexadecimal): 67 A2 8F 8D 40 00 00 00 00	The V_π of arm YI is 4.423783V.

[1] This command can only be used when bias controller is stabilized (LED constantly ON).

ReadStatus	
Command ID	0x69
Description	Get current operating status of bias controller.
Data Send	NA
Data Received	Operating Status. (0x01: Stabilizing; 0x02: Start Tracking; 0x03: Feedback light too weak; 0x04: Feedback light too strong; 0x05: Manual control mode.)
	Data byte length: 1.
Example	Send content (Hexadecimal): 69 00 00 00 00 00 00

Example (cont.)		
	Received content (Hexadecimal): 69 01 00 00 00 00 00 00 00	Bias controller is currently in Stabilizing status.

PauseControl[1]	
Command ID	0x73
Description	Pause the bias controller's auto-tracking program.
Data Send	NA
Data Received	Operation Result.
	Data byte length: 1.
Example	Send content (Hexadecimal): 73 00 00 00 00 00 00

	Received content (Hexadecimal): 73 11 00 00 00 00 00 00 00	Setting Status: Succeed
	Received content (Hexadecimal): 73 88 00 00 00 00 00 00 00	Setting Status: Failed

ResumeControl[1]	
Command ID	0x74
Description	Resume the bias controller's auto-tracking program.
Data Send	NA
Data Received	Operation Result.
	Data byte length: 1.
Example	Send content (Hexadecimal): 74 00 00 00 00 00 00

	Received content (Hexadecimal): 74 11 00 00 00 00 00 00 00	Setting Status: Succeed
	Received content (Hexadecimal): 74 88 00 00 00 00 00 00 00	Setting Status: Failed

Reset	
Command ID	0x6D
Description	Reset the bias controller.
Data Send	NA
Data Received	NA
Example	Send content (Hexadecimal): 6D 00 00 00 00 00 00
	Received content (Hexadecimal): NA

[1] This command can only be used when bias controller is stabilized (LED constantly ON).

SetDitherAmp[1]	
Command ID	0x6F
Description	Set dither amplitude at modulator's specific arm. **Note:** DitherAmpYI, DitherAmpYQ, DitherAmpXI and DitherAmpXQ are set to 1 in factory default, when user set a new value to the controller, it will be stored in Flash memory and automatically loaded when the controller is turned on or reset.
Data Send	**DitherAmpYI (byte one), DitherAmpYQ (byte two),** **DitherAmpXI (byte three), DitherAmpXQ (byte four).** **(**It can only be the multiple of $1\%V_\pi$ and maximum dither amplitude is 20%. For example, if DitherAmpYI is set to 3. Then dither amplitude on arm YI will be 3%.**).**
	Data byte length: 4.
Data Received	Operation Result.
	Data byte length: 1.
Example	Set dither amplitude of arm YI to $2\%V_\pi$; Set dither amplitude of arm YQ to $2\%V_\pi$. Set dither amplitude of arm XI to $3\%V_\pi$; Set dither amplitude of arm XQ to $3\%V_\pi$.
	Send command (Hexadecimal): 6F 02 02 03 03 00 00

Example	Received content (Hexadecimal): 6F 11 00 00 00 00 00 00 00	Setting Status: Succeed
	Received content (Hexadecimal): 6F 88 00 00 00 00 00 00 00	Setting Status: Failed

SetPolar	
Command ID	0x6C
Description	Set polar of bias controller.
Data Send	**Polar-YI (byte one), Polar-YQ (byte two), Polar-YP (byte three),** **Polar-XI (byte four), Polar-XQ (byte five), Polar-XP (byte six).** (Polar-YI: polar of Arm YI; Polar-YQ: polar of Arm YQ; Polar-YP: polar of Arm YP; Polar-XI: polar of Arm XI; Polar-XQ: polar of Arm XQ; Polar-XP: polar of Arm XP. Positive:0x01; Negative:0x02)
	Data byte length: 6.
Data Received	Operation Result.
	Data byte length: 1.
Example	Set polar of arm YI to Negative; Set polar of arm YQ to Negative; Set polar of arm YP to Positive. Set polar of arm XI to Negative; Set polar of arm XQ to Negative; Set polar of arm XP to Positive.
	Send command (Hexadecimal): 6C 02 02 01 02 02 01

Example	Received content (Hexadecimal): 6C 11 00 00 00 00 00 00 00	Setting Status: Succeed
	Received content (Hexadecimal): 6C 88 00 00 00 00 00 00 00	Setting Status: Failed

[1] This command can only be used when bias controller is stabilized (LED constantly ON).

SetDAC[1]	
Command ID	0x6B
Description	Set output voltage at modulator's specific arm. **Note:** This function should be only used when the bias controller is at manual control mode.
Data Send	**Arm (byte one), Voltage (byte two-byte four).** **Arm :**(0x01: Arm YI; 0x02: Arm YQ; 0x03: Arm YP, 0x04: Arm XI; 0x05: Arm XQ; 0x06: Arm XP) **Voltage:** Three bytes. For example, if 3.215V is required for output, the voltage should be multiplied by 1000 to convert the value to integer, i.e. 3215. Then convert 3215 to hex format. Hex format of 3215 is 0x0C8F. Byte one is upper of the final hex result, i.e. 0x0C. Byte two is the lower half, i.e. 0x8F. Byte three is sign of the voltage, 0x00 for positive, 0x01 for negative. Unit: V.
	Data byte length: 4.
Data Received	Operation Result.
	Data byte length: 1.
Example	Set output voltage of arm YI to -4.5V.
	Send content (Hexadecimal): 6B 01 11 94 01 00 00

Example	Received content (Hexadecimal): 6B 11 00 00 00 00 00 00 00	Setting Status: Succeed
	Received content (Hexadecimal): 6B 88 00 00 00 00 00 00 00	Setting Status: Failed

SetMode[1]	
Command ID	0x6A
Description	Set control mode of the bias controller to be auto-tracking mode or manual control mode.
Data Send	**Control Mode.** (0x01: Auto-tracking mode; 0x02: Manual control mode)
	Data byte length: 1.
Data Received	Operation Result.
	Data byte length: 1.
Example	Set manual control mode.
	Send content (Hexadecimal): 6A 02 00 00 00 00 00

Example	Received content (Hexadecimal): 6A 11 00 00 00 00 00 00 00	Setting Status: Succeed
	Received content (Hexadecimal): 6A 88 00 00 00 00 00 00 00	Setting Status: Failed

[1] This command can only be used when bias controller is stabilized (LED constantly ON).

Revision History		
Version	Content	Date
1.0.0	First Release	2021/8/12
1.0.1	Description Correction	2021/9/11
1.0.2	Description Correction	2021/9/13