PlugTech
PRECISION SYSTEMS

UART Operation Manual
For MZM Bias Controller

Table of Contents

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

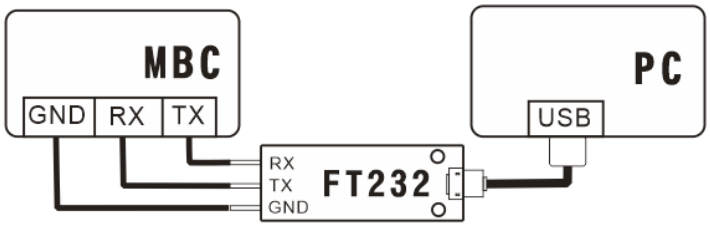
For FT232 Module:
Driver download address (32bit windows):
http://www.waveshare.net/w/upload/1/1f/FT232_Driver.7z
Driver download address (64bit windows):
http://www.waveshare.net/w/upload/4/49/CDM_v2.12.06_WHQL_Certified.zip
Other information:
http://www.waveshare.net/w/upload/d/d0/FT232-USB-UART-Board-UserManual.pdf

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.

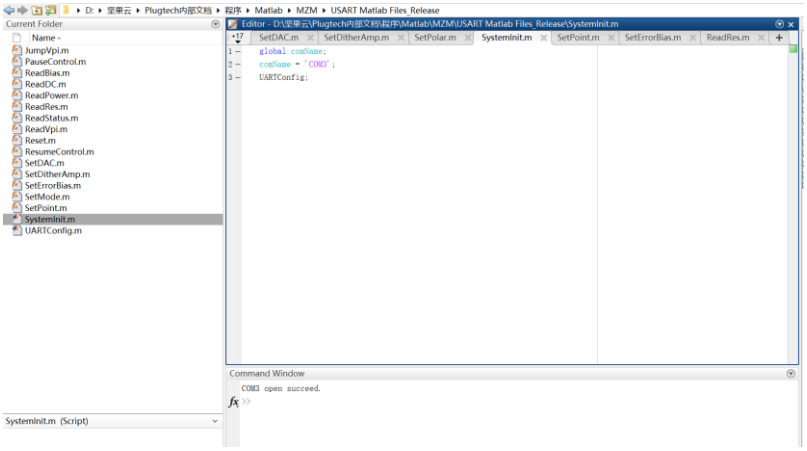


3. Command Execution

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.



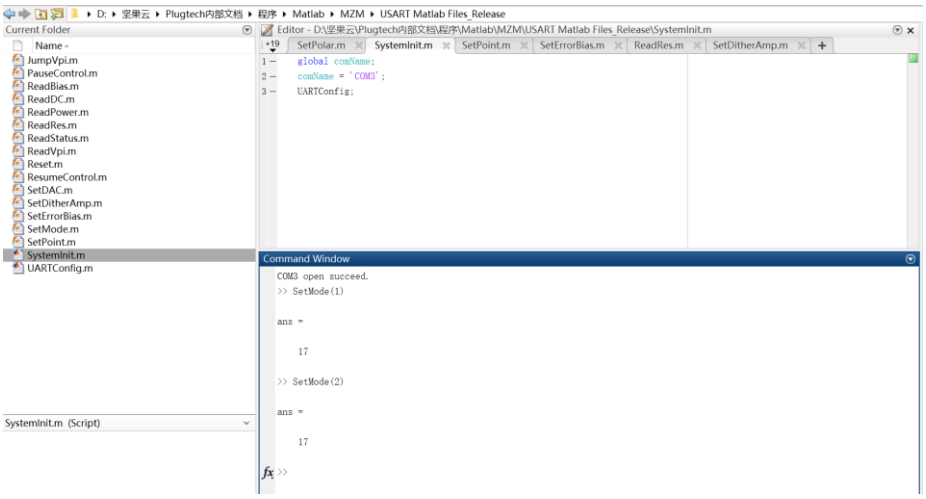
b. Open SystemInit.m file, change comName to the com port name that the USB-UART Converter installed on your computer. You can check the COM port number in device manager if you are using Windows. In this case, we use COM3.

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[1]
Description: Read bias voltage output of bias controller.
Value Sent: NA.
Value Received: Bias voltage output of bias controller. Unit: V.

2.ReadVpi.m

Function: ReadVpi[1]
Description: Read V_π of modulator.
Value Sent: NA.
Value Received: V_π of modulator. Unit: V.

3.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.

4.ReadStatus.m

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

5.ReadPoint.m

Function: ReadPoint[1]
Description: Read current working point of bias controller.
Value Sent: NA.
Value Received: Current working point of bias controller.

6.ReadDitherAmp.m

Function: ReadDitherAmp
Description: Read current DitherAmp coefficient of bias controller.
Value Sent: NA.
Value Received: Current DitherAmp coefficient.

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

7.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.

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 (Voltage)[1]
Description: Set output voltage at modulator.
Value Sent: 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.SetPoint.m

Function: SetPoint (Point)
Description: Set working point of bias controller.
Value Sent: Point (1: Peak point; 2: Null point; 3: Quad+ point; 4: Quad- point).
Value Received: ans=17 (Succeed); ans=136 (Failed).
Note: This function can be only used when the controller's CS pins was inserted by Jumper.

12.JumpVpi.m

Function: JumpVpi (Direction)
Description: Jump to the adjacent working point of the modulator.
Value Sent: Direction (0x01: Forward; 0x02: Backward)
Value Received: ans=17 (Succeed); ans=136 (Failed).
Note: It can't jump to adjacent working point if voltage after jump exceeds the voltage output range.

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

13.SetErrorBias.m

Function: SetErrorBias (Offset)
Description: Adjust control point to arbitrary point.
Value Sent: Offset (It can only be the multiple of 0.3mV. For example, when Offset is set to10, then offset voltage is 3mV.).
Value Received: ans=17 (Succeed); ans=136 (Failed).
Note: Offset is set to 0 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. When Offset is positive, working point will be locked at default working point voltage + offset voltage. When Offset is negative, working point will be locked at default working point voltage – offset voltage. Default working point voltage is bias controller's auto-tracking point (peak/null/Q+/Q-).

14. SetDitherAmp.m

Function: SetDitherAmp (DitherAmp)[1]
Description: Set dither amplitude at bias controller's bias output.
Value Sent: DitherAmp (When controller is tracking peak/null point, it can only be set the multiple of 0.1%Vπ and maximum dither amplitude is 2%, if DitherAmp is set to 3, then dither amplitude will be 0.3%V_π. When controller is tracking Q+/Q- point, it can only be set the multiple of 2%Vπ and maximum dither amplitude is 20%, if DitherAmp is set to 3, then dither amplitude will be 6%V_π.**)**
Value Received: ans=17 (Succeed); ans=136 (Failed).
Note: DitherAmp is 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.

15.Reset.m

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

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

3.2 Execute commands through GUI

A. Condition

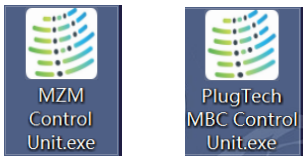
a. GUI software is developed for Windows OS.

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

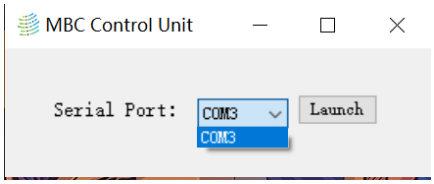
B. Run GUI Software

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

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



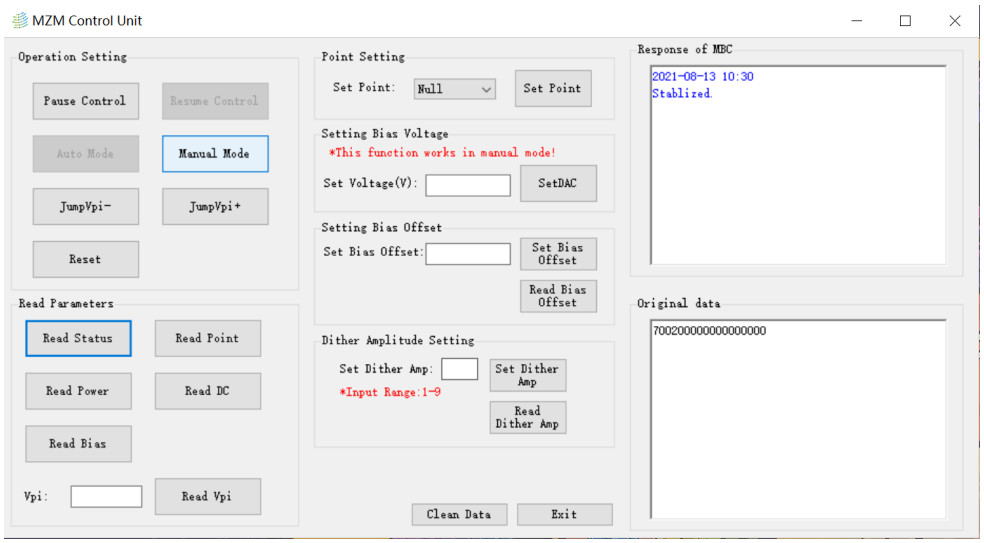
c. Select com port that the USB-UART Converter installed on your computer, then click Launch button to enter control platform. COM port can be detected automatically if USB-UART driver installed properly. COM port number can be found in Windows device manager.



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 bias controller 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 bias controller 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.

- **JumpVpi-[1]:**
  Minus 2 V_π to current bias voltage.

- **JumpVpi+[1]:**
  Plus 2 V_π to current bias voltage.

- **Reset:**
  Reset the bias controller. It will start from initialization.

- **Read Status:**
  Read current operation status of bias controller.

- **Read Point[1]:**
  Read current working point of bias controller.

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

- **Read DC:**
  Read current voltage of bias controller's DC channel (unit: V).

- **Read Bias[1]:**
  Read current bias voltage of bias controller (unit: V).

- **Read Vpi[1]:**
  Read V_π value of modulator (unit: V).

- **Point Setting:**
  Change the working point of bias controller.
  Note: This function can be only used when the bias controller's CS pins was inserted by Jumper.

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

- **Setting Bias Voltage[1]:**
  Change the output voltage in manual control mode.

- **Set Bias Offset[1]:**
  Adjust control point to arbitrary point. It can only be the multiple of 0.3mV. For example, when Offset is set to10, the bias offset is 3mV.
  Note: Offset is set to 0 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. When Offset is positive, working point will be locked at default working point voltage + offset voltage. When Offset is negative, working point will be locked at default working point voltage -offset voltage. Default working point voltage is bias controller's auto-tracking point (peak/null/Q+/Q-).

- **Read Bias Offset[1]:**
  Read current offset value of bias controller.

- **Set Dither Amp[1]:**
  Set dither amplitude of bias controller's output. When controller is tracking peak/null point, it can only be set the multiple of 0.1%Vπ, if DitherAmp is set to 3, then dither amplitude will be 0.3%V_π. When controller is tracking Q+/Q- point, it can only be set the multiple of 2%Vπ, if DitherAmp is set to 3, then dither amplitude will be 6%V_π.
  Note: Dither Amp is 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.

- **Read Dither Amp[1]:**
  Read current Dither Amp coefficient of bias controller.

[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

ReadPoint[1]		
Command ID	0x9A	
Description	Read working point of bias controller.	
Data Send	NA	
Data Received	Current working point of bias controller. Byte one=0x02&Byte two=0x01: Null point; Byte one=0x02&Byte two=0x02: Peak point; Byte one=0x03&Byte two=0x01: Quad+ point; Byte one=0x03&Byte two=0x02: Quad- point.	
	Data byte length: 2.	
Example	Send content (Hexadecimal): 9A 00 00 00 00 00 00	
	Received content (Hexadecimal): 9A 02 02 00 00 00 00 00 00	Bias controller is tracking peak point.

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

ReadBias[1]		
Command ID	0x68	
Description	Read bias voltage of bias controller.	
Data Send	NA.	
Data Received	4 byte floating point number (Little Endian). Unit: V.	
	Data byte length: 4.	
Example	Send content (Hexadecimal): 68 01 00 00 00 00 00	
	Received content (Hexadecimal): 68 5C 98 85 C0 00 00 00 00	The output voltage of bias controller is -4.174829V.

ReadPower		
Command ID	0x67	
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): 67 00 00 00 00 00 00	
Example	Received content (Hexadecimal): 67 22 F5 1F 41 00 00 00 00	The optical power is 10uW.

ReadVpi[1]		
Command ID	0x69	
Description	Read V_π of modulator.	
Data Send	NA.	
Data Received	4 byte floating point number (Little Endian). Unit: V.	
	Data byte length: 4.	
Example	Send content (Hexadecimal): 69 01 00 00 00 00 00	
	Received content (Hexadecimal): 69 A2 8F 8D 40 00 00 00 00	The V_π of modulator is 4.423783V.

ReadStatus		
Command ID	0x70	
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): 70 00 00 00 00 00 00	
	Received content (Hexadecimal): 70 01 00 00 00 00 00 00 00	Bias controller is currently in Stabilizing status.

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

ReadDitherAmp[1]		
Command ID	0x9B	
Description	Get dither amplitude coefficient of bias controller.	
Data Send	NA	
Data Received	Dither amplitude coefficient.	
	Data byte length: 1.	
Example	Send content (Hexadecimal): 9B 00 00 00 00 00 00	
	Received content (Hexadecimal): 9B 03 00 00 00 00 00 00	Dither amplitude coefficient is 3.

SetDitherAmp[1]		
Command ID	0x72	
Description	Set dither amplitude at modulator. **Note:** DitherAmp 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	**DitherAmp. (**When controller is tracking peak/null point, it can only be set the multiple of 0.1%Vπ and maximum dither amplitude is 2%, if DitherAmp is set to 3, then dither amplitude will be 0.3%V_{π}. When controller is tracking Q+/Q- point, it can only be set the multiple of 2%Vπ and maximum dither amplitude is 20%, if DitherAmp is set to 3, then dither amplitude will be 6%V_{π}.**)**.	
	Data byte length: 1	
Data Received	Operation Result.	
	Data byte length: 1.	
Example	Set dither amplitude to 0.3%Vπ when the controller is tracking null point.	
	Send command (Hexadecimal): 72 03 00 00 00 00 00	
	Received content (Hexadecimal): 72 11 00 00 00 00 00 00	Setting Status: Succeed
	Received content (Hexadecimal): 72 88 00 00 00 00 00 00	Setting Status: Failed

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

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

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

JumpVpi[1]		
Command ID	0x6F	
Description	Jump to the adjacent working point of the modulator. **Note:** It can't jump to adjacent working point if voltage after jump exceeds the voltage output range.	
Data Send	**Direction.** (0x01: Forward; 0x02: Backward)	
	Data byte length: 1.	
Data Received	Operation Result.	
	Data byte length: 1.	
Example	Minus $2V_{\pi}$ to current working point.	
	Send content (Hexadecimal): 6F 02 00 00 00 00 00	
	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

SetMode[1]		
Command ID	0x6B	
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): 6B 02 00 00 00 00 00	
	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

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

SetErrorBias[1]		
Command ID	0x71	
Description	Adjust control point to arbitrary point, it can only be the multiple of 0.3mV. **Note:** Offset is set to 0 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. When Offset is positive, working point will be locked at default working point voltage + offset voltage. When Offset is negative, working point will be locked at default working point voltage -offset voltage. Default working point voltage is bias controller's auto-tracking point (peak/null/Q+/Q-).	
Data Send	**Offset (byte one-byte two):** Two bytes. The first byte is the upper half of offset value in hexadecimal format while the second byte is the lower half. **Sign (byte three):** 0x01: negative; 0x02: positive.	
	Data byte length: 3.	
Data Received	Operation Result.	
	Data byte length: 1.	
Example	Make controller add 1000 DAC steps to current working point.	
	Send content (Hexadecimal): 71 03 E8 02 00 00 00	
	Received content (Hexadecimal): 71 11 00 00 00 00 00 00 00	Setting Status: Succeed
	Received content (Hexadecimal): 71 88 00 00 00 00 00 00 00	Setting Status: Failed

SetPoint		
Command ID	0x76	
Description	Set working point of bias controller. **Note:** This function can be only used when the bias controller's CS pins was inserted by Jumper.	
Data Send	**Point (byte one-byte two):** [0x01,0x02]: Peak point; [0x01,0x01]: Null point; [0x02,0x01]: Quad+ point; [0x02,0x02]: Quad- point.	
	Data byte length: 2.	
Data Received	Operation Result.	
	Data byte length: 1.	
Example	Set working point to peak point.	
	Send command (Hexadecimal): 76 01 02 00 00 00 00	
	Received content (Hexadecimal): 76 11 00 00 00 00 00 00 00	Setting Status: Succeed
	Received content (Hexadecimal): 76 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	0x6C	
Description	Set output voltage of bias controller. **Note:** This function should be only used when the bias controller is at manual control mode.	
Data Send	**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 bias controller to -4.5V.	
	Send content (Hexadecimal): 6C 01 11 94 01 00 00	
	Received content (Hexadecimal): 6C 11 00 00 00 00 00 00	Setting Status: Succeed
	Received content (Hexadecimal): 6C 88 00 00 00 00 00 00	Setting Status: Failed

Reset	
Command ID	0x6E
Description	Reset the bias controller.
Data Send	NA
Data Received	NA
Example	Send content (Hexadecimal): 6E 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).

Revision History		
Version	Content	Date
1.0.0	First Release	2021/8/13
1.0.1	Description Correction	2021/9/11
1.0.2	Description Correction	2021/9/13
1.0.3	UART Command List's SetPoint Correction	2021/12/29