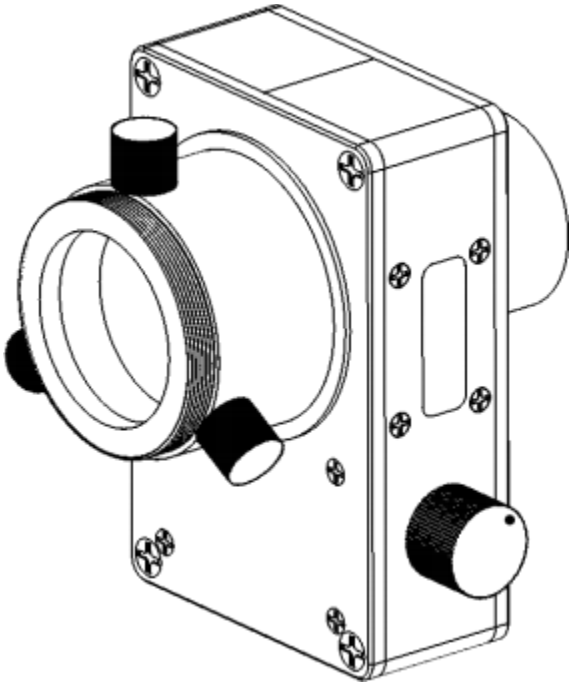
USER MANUAL

Electric atmospheric dispersion corrector



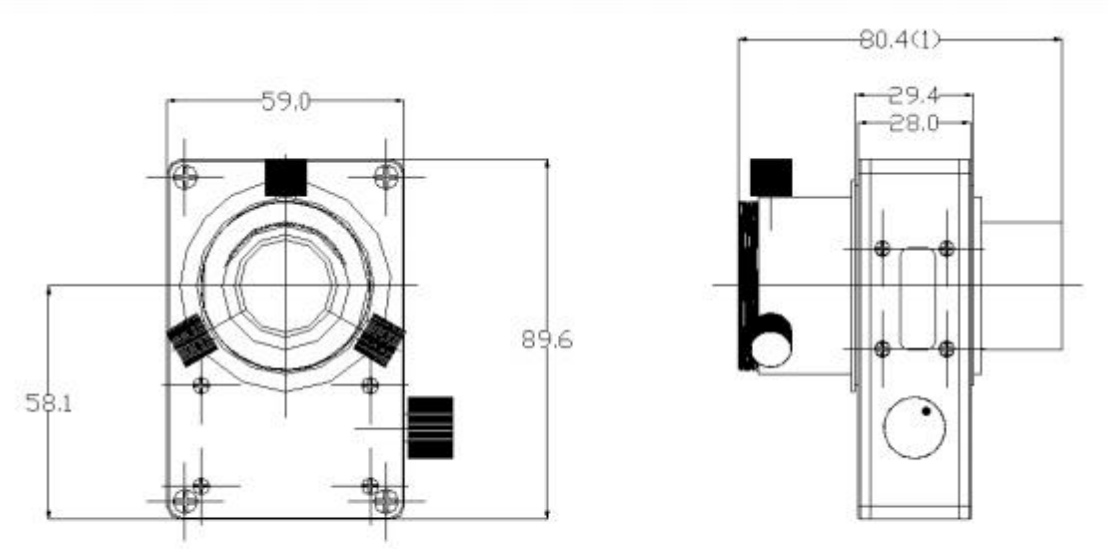
V2.0

Four-piece None-displacement eADC (Premier Edition)

The Four-piece None-displacement electric atmospheric dispersion corrector (eADC) developed by the SUNOBSERVER is a device with an inclination sensor, which can sense the current attitude of eADC and calculate the current dispersion compensation through user setting. After calibration there is no need to calibrate again when the target altitude angle changes slightly. When the Equatorial rotates, it will automatically adjust the level according to the accelerate sensor without manually intervention. The instrument will automatically retrieve its position when the equatorial mount cross the zenith flip. It can be used on the Newton reflection telescope. The name None-displacement suggests that there won't be any position shifting of the image when you make adjustments, thus ensuring a better image quality.

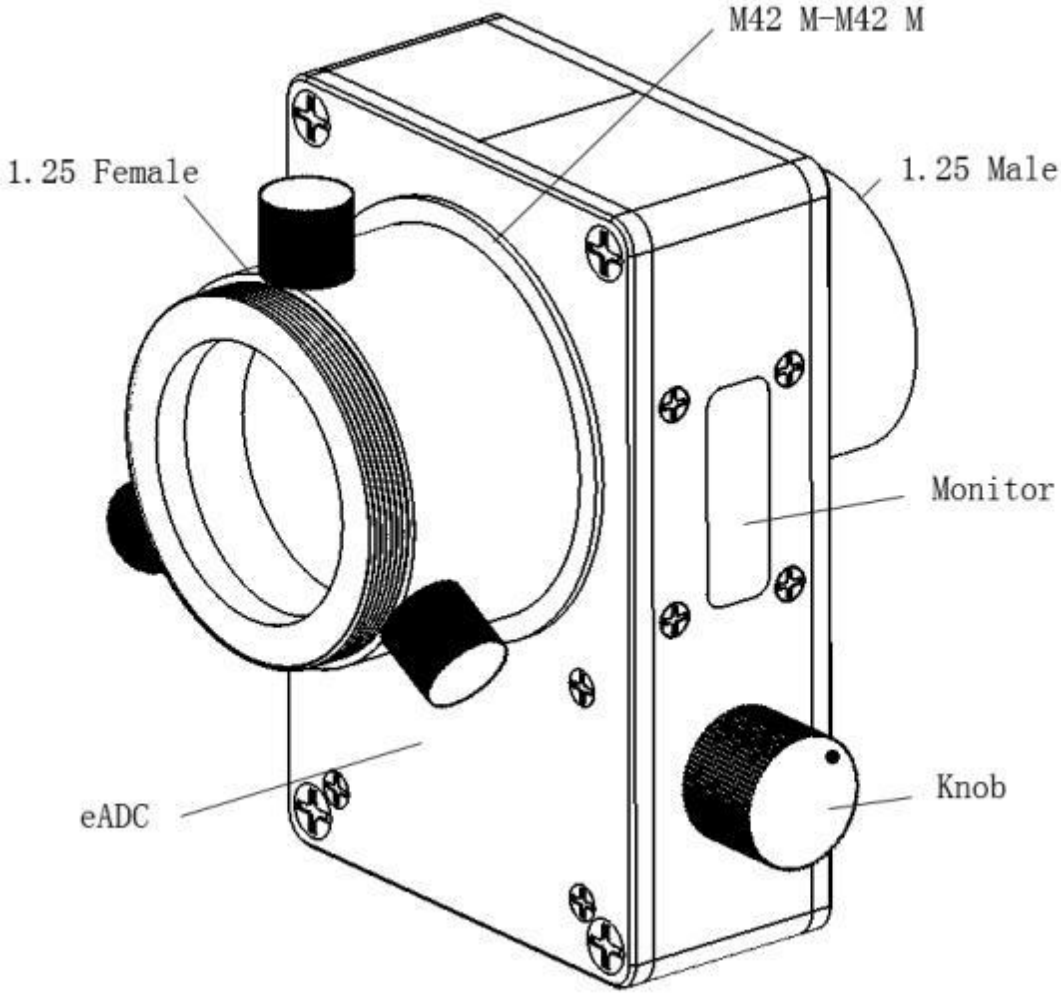
eADC can be used offline or online. The setting of eADC can be changed through the computer operation terminal, and the parameter changes made by the operation knob of eADC can also be read through the computer operation terminal.

Basic parameters of eADC are shown in the following table.



Items	Parameters	Notes
Supply voltage	5V DC	4.5V-5.5V
Current consumption	400mA max	The power supply capacity shall not be less than 400mA
Prism material	H-F4 H-ZK9B	Two sets/Four pieces
Edge angle	5.7°	
Coating	400nm-700nm Anti-Reflective	
Optical aperture	22mm	
Weight	267g	
Dimensions	59.0mm*89.6mm*80.4mm (1)	(1) Use dimensions with caution

Note: the content of this product may change without notice due to improvements in design.



Basic operation of electric eADC：

1: The power supply specification of eADC is DC 5V, the positive and negative deviation is 0.5V (4.5v-5.5v), and the capacity of the power supply is not less than 400mA. It can be powered by a mobile power supply that meets the voltage standard or the USB port of the computer. After being connected to the power , it is in the initialization stage when the first line of the display screen shows *Initializing*. About a minute later, when *Initializing* becomes *Smart eADC*, it turns into the working mode.

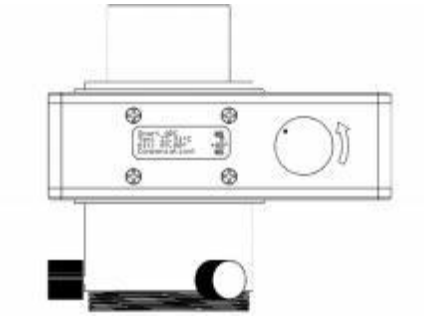
2: Connect the camera, and when the target come into view , adjust the compensation coefficient. Make the red and blue colorno longer appear on the target edge. You can increase the exposure and maximize the saturation, or minimize the green channel gain at the same time to help your adjustment . You can also use the ADC alignment function of ASICAP or the ADC alignment function of sharpcap 4.0 or newer to help the judgement. If you can't align the red and blue by only adjusting the compensation, you can adjust the third parameter for horizontal tilt compensation to minimize the error. Generally, after the target with a height angle of about 30 degrees is adjusted, the target with a higher angle does not need to be adjusted again. eADC can automatically adjust itself

according to the angle and the current compensation coefficient. For the sake of preciseness, it is recommended to check the alignment again after replacing the target.

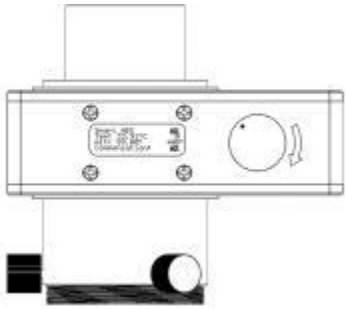
3: For visual adjustment, first adjust the compensation coefficient until the atmospheric dispersion is not visible. If there is still visible chromatic aberration on the left and right horizontal directions of the edge, adjust the horizontal tilt compensation in the third row.

Rotary encoder Operation:

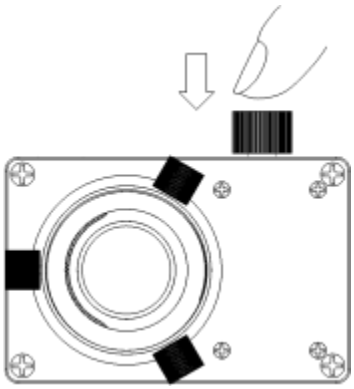
Rotate the encoder counterclockwise and the highlighted parameter on the display will decrease. The settings will be automatically saved 4 seconds later after the adjustment stops. If there is a data-changing operation within 4 seconds, it will take another 4 seconds to save the data.



Rotate the encoder clockwise and the highlighted parameter on the display will increase. The setting will be automatically saved 4 seconds later after the adjustment stops. If there is a data change operation within 4 seconds, it will take another 4 seconds to save the data.



Press the encoder down, and the highlighted area will jump to the next parameter to be adjusted. After jumping to the lowest line of parameters, continue to press to return to the first parameter. Each time you start the machine, the adjustable parameter defaults to the dispersion compensation coefficient. Press once to jump to the mode selection, then press again to jump to the tilt compensation. Press once more and you return to the dispersion compensation coefficient. When you press constantly, the highlight selection will cycle over the three parameters: dispersion compensation coefficient - mode - tilt compensation.



Instructions on displayed parameters：

When the highlighted area is on the compensation coefficient number(1st line), the fourth line on the screen displays *Compensation* and the parameters currently being adjusted. Adjust the knob clockwise to increase the number, and rotate the knob counterclockwise to decrease the number.

When the highlighted area is on the mode number(2nd line), the fourth line on the screen displays *Mode* and the parameters currently being adjusted. Adjust the knob clockwise to increase the number, and rotate the knob counterclockwise to decrease the number.

Note: After switching the mode, you need to wait for 4 seconds for the data to be saved, and wait until the system automatically restarts to work in the new mode.

Do not power offor send a restart command before the system automatically restart, otherwise the mode change cannot be saved.

When the highlighted area is on the tilt compensation number(3rd line), the fourth line of the screen displays *Tilt* and the parameters currently being adjusted. Adjust the knob clockwise to increase the number, and rotate the knob counterclockwise to decrease the number.

Operating mode description:

Mode0：

Refractor, catadioptric, Cassegrain and other systems that directly form inverted image use mode 0.

There shall be no image conversion device between the eADC and the main mirror, such as a zenith telescope, semi positive or full positive prism or prism group, half positive or full positive mirror or mirror group and so on.

When the zenith mirror needs to be installed for visual inspection, the zenith telescope can be installed behind the eADC without affecting the operation of mode 0.

Note: If you need install eADC behind a semi-positive zenith telescope, adjust eADC to Mode1 and then switch the positions of male and female fittings.

Note: The use behind the positive zenith telescope and positive prism mirror is not supported.

Mode1：

Systems with a 90-degree turning mirror, such as Newton reflection telescope, should work in mode 1.

Note: If a 90-degree semi-positive zenith telescope is added to a refractor, catadioptric or Cassegrain, and eADC is installed behind the semi-positive zenith telescope to work in Mode1, remember to switch the positions of male and female fittings.

Horizontal tilt compensation：

Because the two compensation prisms are arranged in front and back, and can only be arranged in front and back, the result of symmetrical adjustment is not strictly symmetrical, and the result of dispersion compensation is not strictly perpendicular to the horizontal. There will be a slight tilt with the change of altitude, and the result is a slight chromatic aberration on the left or right side of the target. Horizontal tilt compensation is to eliminate this chromatic aberration. Because this effect is very slight, it is difficult to detect when viewing real-time images.

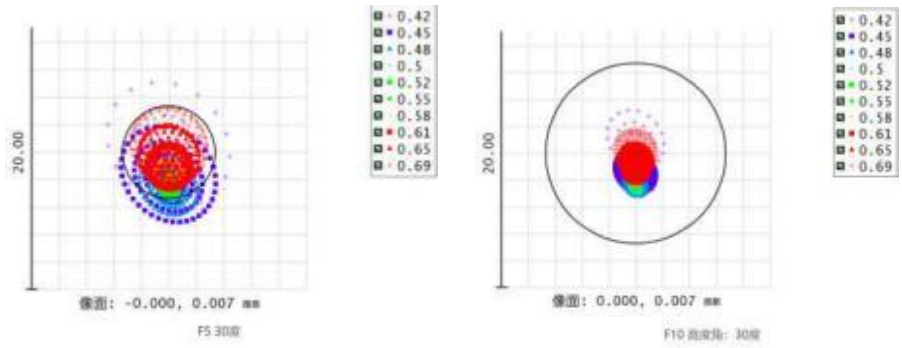
It is recommended to check the tilt after photographing and stacking hundreds of frames, and then compensate appropriately according to the tilt degree, or use the ADC alignment assist in sharpcap 4.0 or newer.

Installation：

Because the eADC is an optical device composed of four prisms, the unequal thickness of prisms will cause optical path differences at different positions during compensation. This effect is negligible on F10 and slower telescopes. However, it will have a certain impact on the imaging of telescopes faster than F10, such as F7, F5, F4 and other faster telescopes, and it is recommended to add it behind the teleconverter.

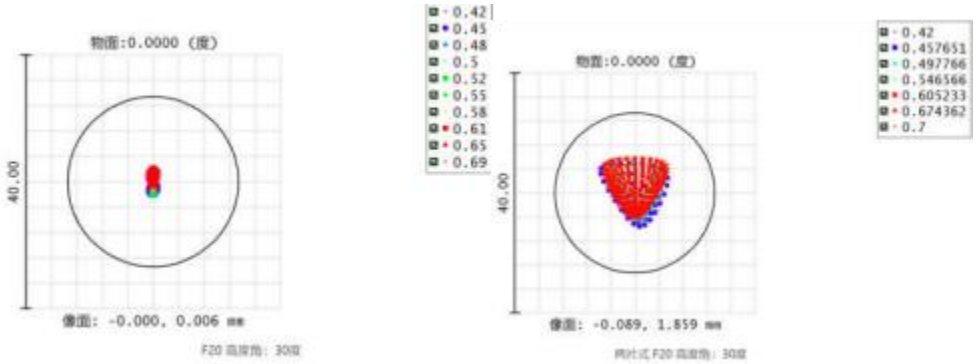
When the camera is directly connected to the eADC, try to keep the sensor chip away from the prism of the eADC if possible. If it is too close to the prism, it is possible that the maximum compensation of the prism cannot correct the atmospheric dispersion, and the dust on the prism will also affect the imaging.

The following chart shows how under F5 focal ratio the differences in refractive index among different wavelengths cause parfocalization failure and chromatic aberration, while under F10 focal ratio both chromatic aberration and spherical aberration are reduced to a negligible level. Therefore, it is recommended that in a system of faster focal ratio the teleconverter should be put in front of ADC, so that the focal ratio of the light slows down when travel through the lens, thus improving imaging quality.



The comparison between spot diagrams of F5 focal ratio (left) and F10 focal ratio (right)
(with Four-piece ADC)

Since the angel of incidence of light from different spots is quite close to each other in Four-piece ADC, its circle of confusion is smaller than that of Two-piece ADC, which gives it a better imaging quality.

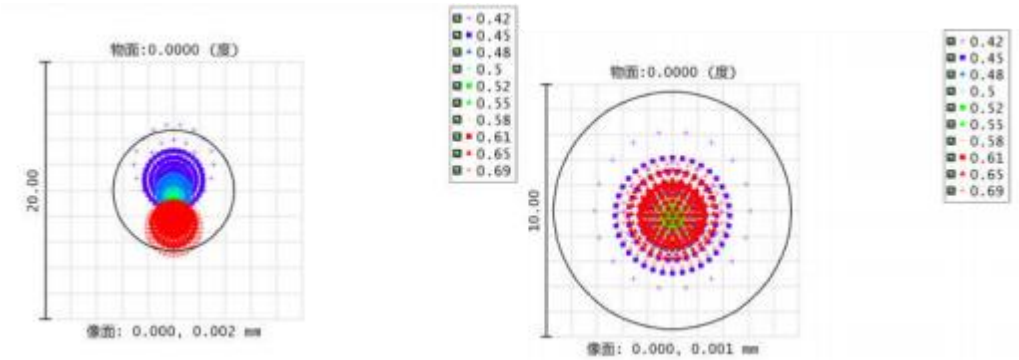


The comparison between spot diagrams of Four-piece None-displacement eADC (left) and traditional Two-piece ADC (right)

Since the compensation of ADC is not infinite, there is a limit on its compensation angle. Generally, the lowest compensation angle is about 10° in a 12-inch F20 system. If a lower target is needed to ensure sufficient compensation, then you have to lengthen the distance between the sensor and ADC lens or the distance between the eyepiece and ADC lens.

Maximum altitude:

There is not only a floor constraint on ADC's working angle, but also a limit on its maximum working angle. Ideally, the light should come perpendicular to the lens. But in reality it is not practical to guarantee that all the time because of the limitation of manufacturing and assembling. The light will enter with a certain angle, causing a slight chromatic aberration in ADC even if it is in 0 position. That is to say it will still make compensation to a certain altitude when it is in 0 position. When the altitude is higher that this, there will be an adverse effect, causing chromatic aberration and lowering system resolution. The maximum altitude for this Four-piece None-displacement eADC is about 82° . Higher than 82° , it will not compensate for chromatic aberration but causing the problem instead. It is recommended to remove ADC when the altitude is higher than 82° .

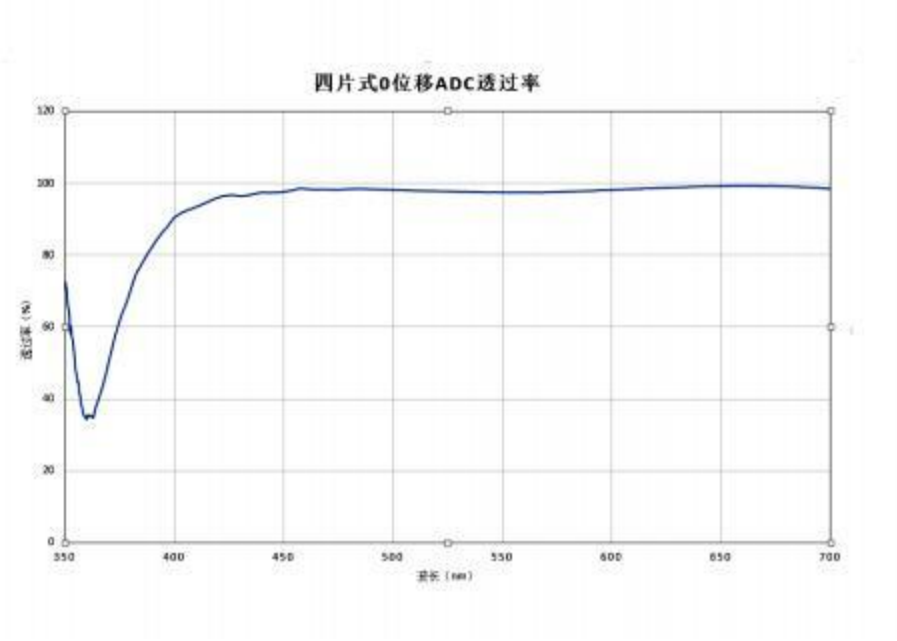


Focal ratio: F7 Altitude: 90° Focal ratio: F7 Altitude: 82°

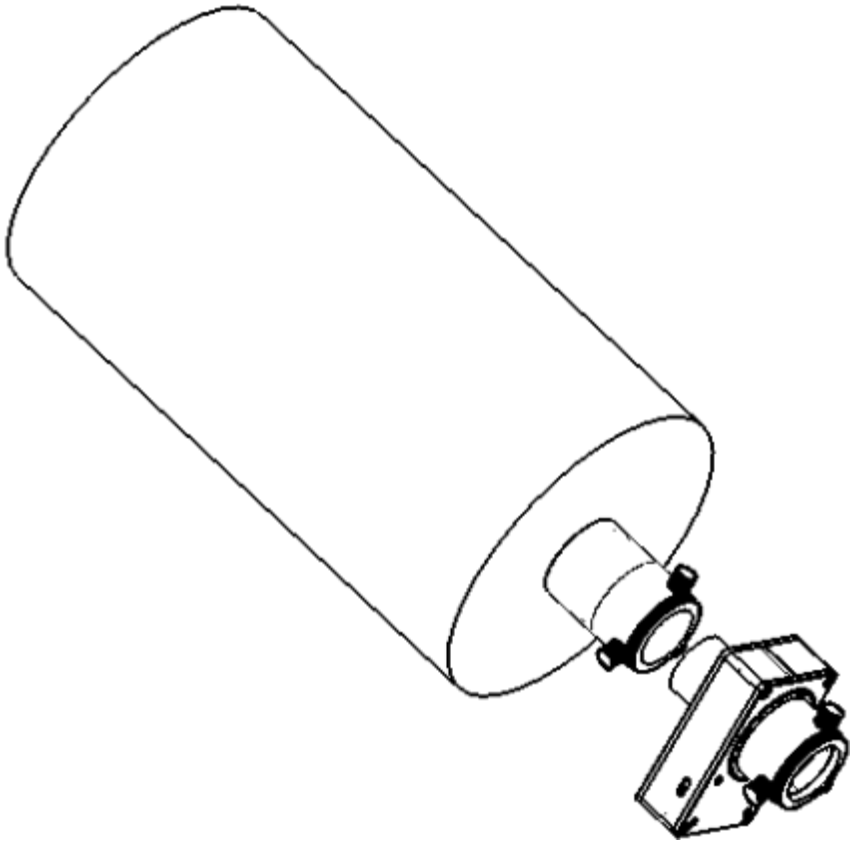
IF you want to avoid chromatic aberration without removing ADC , and work with a +90° at the zenith, you need to use the parallel light system. The parallel light system has no limit on either the maximum altitude or the minimum altitude. It has no limit on focal ratio either, unless the focal ratio is too and make the clear aperture unbearable.

The coating of Four-piece None-displacement eADC is 400nm-700nm anti-reflective coating. Since the materials in it are capable of absorbing ultraviolet rays, and the error of eADC correcting in the ultraviolet band increases, it is not recommended to use it in <400nm wave band.

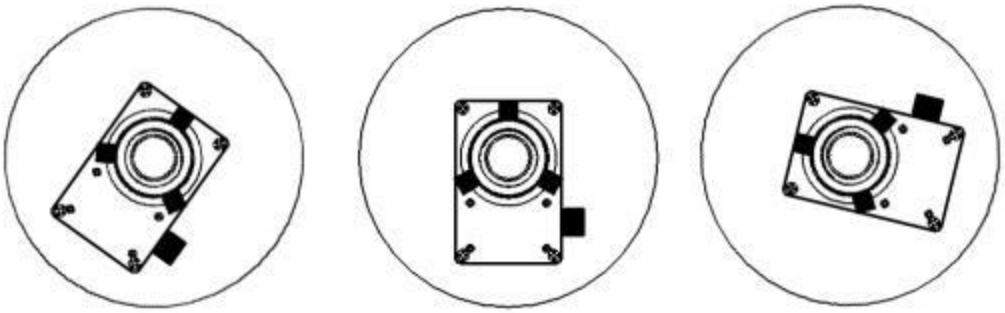
Diagram of ADC light transmittance rate 300nm-700nm



How to install Mode 0:



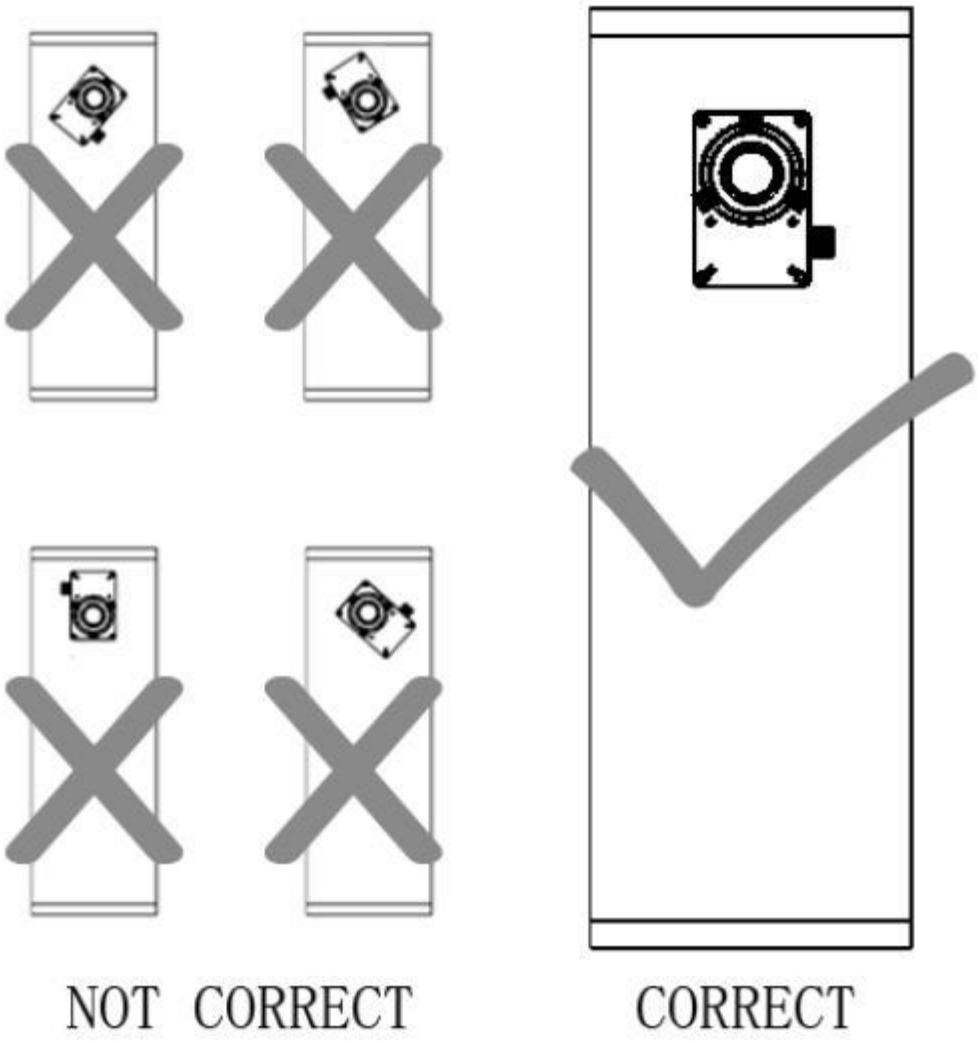
Mode0: Installation diagram of mode 0



In mode 0, when the eADC optical axis is coaxial with the main mirror optical axis, it can be installed at any angle.

Mode 0： The eADC installation on the telescope optical system without optical path turning should work in mode 0 and there is no requirements on the angle. The eADC can be installed at any angle around the optical axis, and the eADC will automatically correct itself according to the tilt angle.

How to install Mode 1:



Mode 1： Installation angle diagram of eADC on Newton reflection telescope

Mode 1： When used on Newton reflection telescope, eADC should work in mode 1. When the eADC in mode 1, the installation angle should meet the following requirement. The longest side of the shell of the eADC should be parallel to the optical axis (or geometric central line) of the Newton reflection telescope. Because the human eye cannot judge accurately, a small error is allowed. The calibration error caused by this can be adjusted in the dispersion compensation and tilt compensation of eADC.

Computer software operation(Windows only):

After the device is connected to PC through USB cable, FT232 virtual serial port driver shall be installed first. FT232 serial driver can be downloaded from the data in chip FT232RQ on FTDI official website.

After the driver is installed, the device will be identified as a virtual serial port in the PC. Right-click the My Computer icon on the desktop and select: Management - Device Manager - Port Option to open and view serial port serial number.

Check the port number of USB serial port in Port Option of Device Manager. For example, it is identified as COM6, which may actually be identified as any serial number, such as COM5, COM17, COM9, etc.

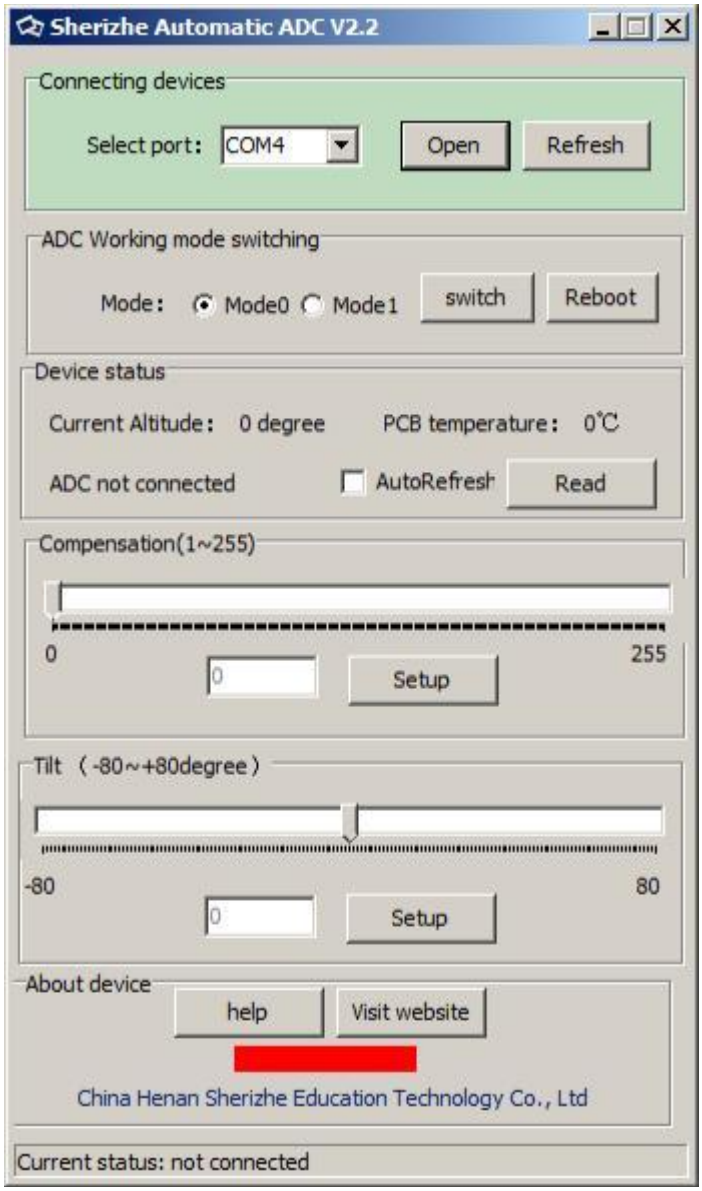
Open the computer software of the SUNOBSERVER electric eADC, select the port - COM6 (the actual port number is subject to the actual computer identification port number, here take COM6 as an example) - click Open. When Current status on the status bar at the bottom of the window changes into Connected to COM6, you can operate to set the parameters.

If there is no recognized virtual serial port in the port bar, click the refresh button.

eADC working mode switching: Select the working mode you need and click Switch. The eADC will automatically restart and initialize 4 seconds later. Do not click the Reboot button before it automatically restarts, otherwise the setting fails.

The Device status displays the current altitude and working temperature. After clicking the Read button, the current altitude, current working temperature, compensation and tilt will be read and displayed in the interface. If AutoRefresh is selected, these parameters will be updated once every 4 seconds. Because of mechanical installation error and other factors, the altitude is for reference only. Because of the spontaneous heating of the circuit board, the current working temperature is for reference only.

Drag the slider with the mouse to set the dispersion compensation amount and horizontal tilt compensation degree. It can also be controlled by the left and right direction keys on the keyboard. After dragging the slider to the predetermined position, click the Setup button to write the parameters into the device.



Instructions on serial port commands:

The communication between electric atmospheric dispersion corrector (eADC) and PC relies on FTDI USB serial port chip FT232RQ. When connected to the computer, the driver that matches the computer system needs to be correctly installed, which can be recognized as a virtual serial port.

Port settings:

Baud rate:9600

Data bit： 8

Check bit: None

Stop bit: 1

Flow control: None

The eADC has a total of 6 commands. The first character of the command format is ‘:’. The following letters are command recognition characters, the first is uppercase, followed by lowercase. The command recognition characters are followed by the command assignment characters, and the content is numeric characters. The command ending character is ‘#’.

Command 1 :CoDDD#

This is the dispersion compensation command. DDD represents 3 digits, and the number format must be 3 digits. If it is less than 3 digits, fill 0 before the number. The value range is 1-999. After sending the command, the last bit of the command will be changed to * and returned.

Eg:

Send :Co123# Return :Co123*

Send :Co025# Return :Co025*

Send :Co001# Return :Co001*

Command 2 :ModeD#

This is the working mode command of eADC. The value range of D can only be either 0 or 1. After sending the command, the last bit of the command will be changed to * and returned.

Eg:

Send :Mode0# Return :Mode0*

Send :Mode1# Return :Mode1*

When the mode is changed, the system will restart automatically after 4 seconds.

Command 3 :Ti+DD#

This meas the horizontal tilt of eADC is compensated clockwise. DD represents 2 digits, and the number format must be 2 digits. If the number is less than 2 digits, 0 shall be added before the number. The number range is 0-80, indicating that the horizontal tilt compensation rotates 0-80 degrees clockwise. After sending the command, the last bit of the command will be changed to * and returned.

Eg:

Send :Ti+05# Return :Ti+05*

Send :Ti+80# Return :Ti+80*

Command 4 :Ti-DD#

This is the horizontal tilt counterclockwise compensation of eADC. DD represents 2 digits, and the number format must be 2 digits. If the number is less than 2 digits, 0 shall be added before the number. The number range is 0-80, indicating that the horizontal tilt compensation rotates 0-80 degrees counterclockwise. After sending the command, the last bit of the command will be changed to * and returned.

Eg:

Send :Ti-05# Return :Ti-05*

Send :Ti+56# Return :Ti-56*

Command 5 :Reset#

This is the restart command of the system. The system restarts immediately after you send this command.

Command 6 :GetAl#

Send this command to obtain the current status data of the system.

It can read the current PCB temperature, current elevation, current compensation coefficient, current working mode and current tilt compensation.

The return is a 10 byte data string, the ASII value starting with the character ':' followed by 8 hexadecimal data. End with '*'.

Return data string definition

Data bit	Content	Definition	Conversion
0	0x3A	Starting character	ASII value of character :
1	0x00-0xff	high 8 bits of temperature value	The temperature value is 16 bit data divided by 100.
2	0x00-0xff	low 8 bits of temperature value	
3	0x00-0xff	high 8 bits of target altitude angle	The angle value is 16 bit data divided by 100 .
4	0x00-0xff	low 8 bits of target altitude angle	
5	0x00-0xff	high 8 bits of the current compensation coefficient	The compensation coefficient is 16 bit data
6	0x00-0xff	low 8 bits of the current compensation coefficient	
7	0x00-0x01	Current working mode	No conversion
8	0x00-0xff	Tilt compensation	When the HEX value turned into DEC number is greater than 90 and less than 180, the tilt compensation is + (decimal number -90) degrees. When the decimal is greater than 0 and less than 90, the tilt compensation is - (decimal number -90) degrees.
9	0x2A	Ending character	ASII value of character *

Example： the returned data are:3A 0D 61 00 0D 00 37 00 5A 2A

3A	:	Starting character
0D	HEX 0X0D61 DEC 3425	34.25centigrade
61		
00	HEX 0X000D DEC 13	Height angle 0.13 degrees
0D		
00	HEX 0X0037 DEC 55	Compensation amount 55
37		
00	0X00	Mode 0
5A	HEX 0X5A DEC 90	tilt compensation +0centigrade
2A	*	Ending character

Commands table

Command	Return value	Function	Value range
:CoDDD#	:CoDDD*	Set dispersion compensation	1-999
:ModeD#	:ModeD*	Set eADC working mode	0, 1
:Ti+DD#	:Ti+DD*	Set tilt compensation clockwise	0-80
:Ti-DD#	:Ti-DD*	Set tilt compensation counterclockwise	0-80
:Reset#		System restart	
:GetAl#	:HHHHHHHH*	Read current system settings	