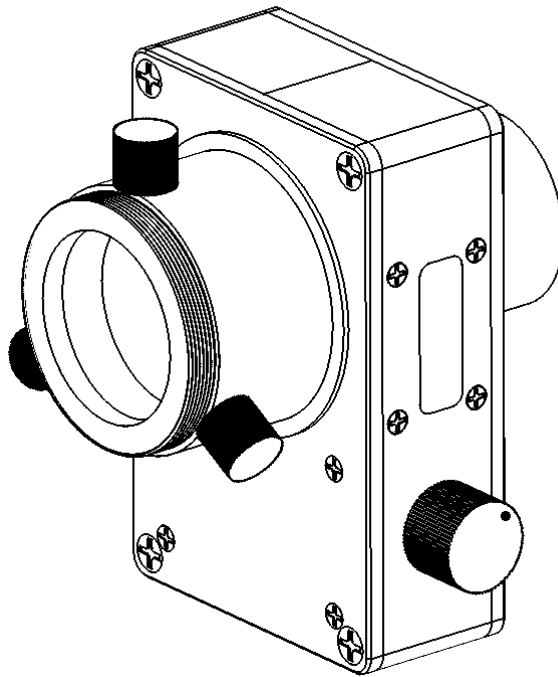


# USER MANUAL

**Zero image shift electric atmospheric dispersion corrector**

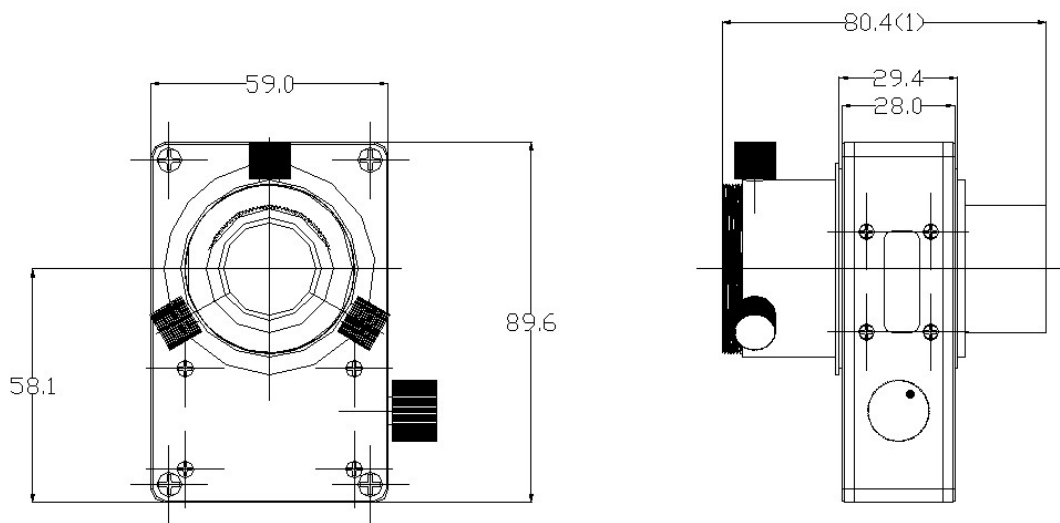


V3.0

Applicable to: Four piece two group atmospheric dispersion corrector

The four piece two group prism electric atmospheric dispersion corrector (eADC) developed by the SUNOBSERVER is a device with a accelerate 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 changed. 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 equatorial mount cross the zenith flip. It can use on the Newton reflection telescope. Zero image shift means that image has no shift duringthe adjustment process, and provides better imaging 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.

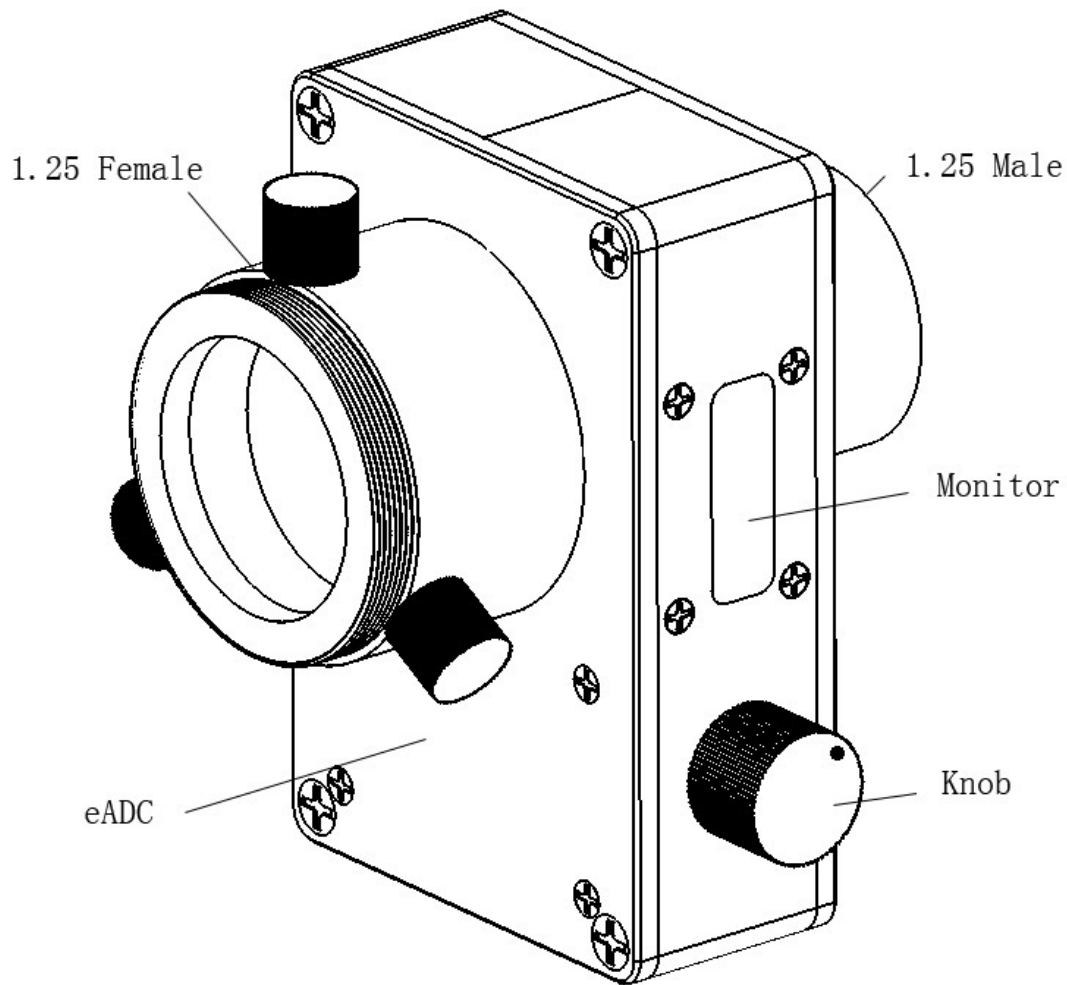


Unit:millimeter

(1)This Dimension for reference only,Use with caution

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	CDGM F4 H-ZK9B	4 pieces 2groups
Prism angle	5.7°	
Coating	350nm-700nm AR	
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 connect the power , it is in the initialization stage when the first line of the display shows initializing. About a minute later, when initializing becomes a smart eADC, it turns to the working mode.

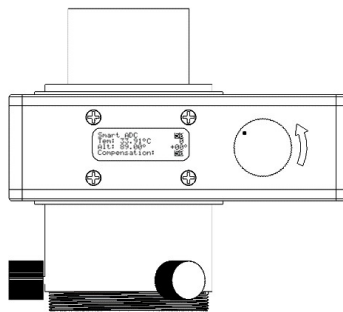
2: connect the camera, when the target come into view , adjust the compensation coefficient. Make the red and blue color no longer appear on the target edge. You can increase the exposure and maximize the saturation, or minimize the green channel gain at the same time to help your adjustment . You can 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 adjust the compensation, you can adjust the third parameter horizontal tilt to minimum 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 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.

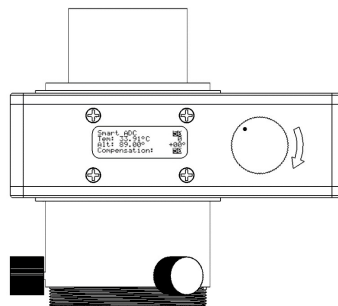
3: For visual adjustment, first adjust the compensation coefficient until the atmospheric dispersion is not visible. If there is still visible color on the left and right horizontal directions of the edge, adjust the horizontal tilt compensation in the third row.

### Rotary encoder Operation:

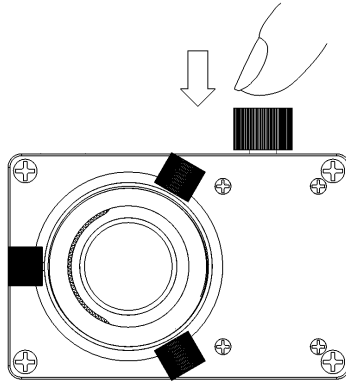
Rotate the encoder counterclockwise and the highlighted parameter on the display will decrease. The setting will automatically saved 4 seconds later after the adjustment stops. If there is a data change operation within 4 seconds, the data saving time will continue to be postponed for 4 seconds.



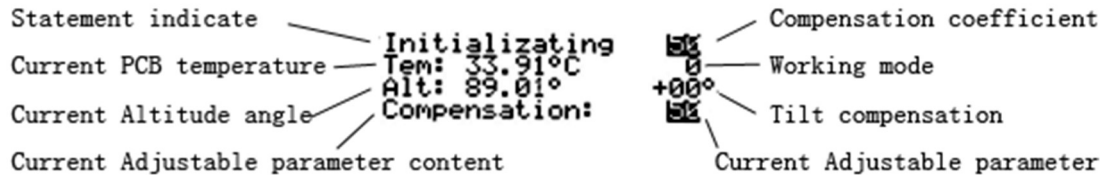
Rotate the encoder clockwise and the highlighted parameter on the display will increase. The setting will automatically saved 4 seconds later after the adjustment stops. If there is a data change operation within 4 seconds, the data saving time will continue to be postponed for 4 seconds.



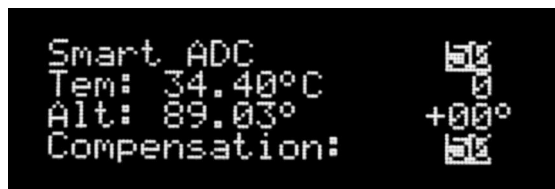
Press the encoder down, and the highlighted area will jump to the next parameter to be adjust. After jumping to the lowest line of parameters, continue to press to return to the first parameter. Each time you start the machine, the adjustable parameter defaults to the dispersion compensation coefficient.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



## Display parameter description:



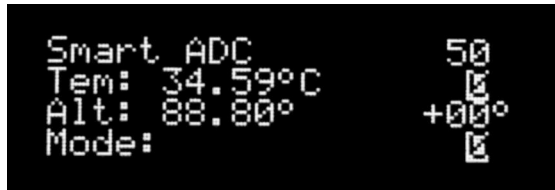
When the highlighted area is on the compensation coefficient number, the fourth line of the display displays compensation and the parameters currently being adjusted. Adjust the knob clockwise to increase the number, and rotate the knob counterclockwise to decrease the number.



When the highlighted area is on the second line mode number, the fourth line of the display displays the mode (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 switch the mode, you need to wait for 4 seconds to save the data, and after the system automatically restart the eADC can be work in new mode.

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



When the highlighted area is on the third line tilt compensation, the fourth line of the display displays tilt (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 zenith mirror or 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 mirror can be installed behind the eADC without affecting the operation of mode 0.

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

### Mode1:

Such as Newton reflection telescope that the optical system have a 90 degrees turning mirror, should work in mode 1.

## 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, and the result is a slight unalignment on the left and right side of the target. Horizontal tilt compensation is to eliminate this unalignment. Because this effect is very slight, it is difficult to detect when viewing real-time images.

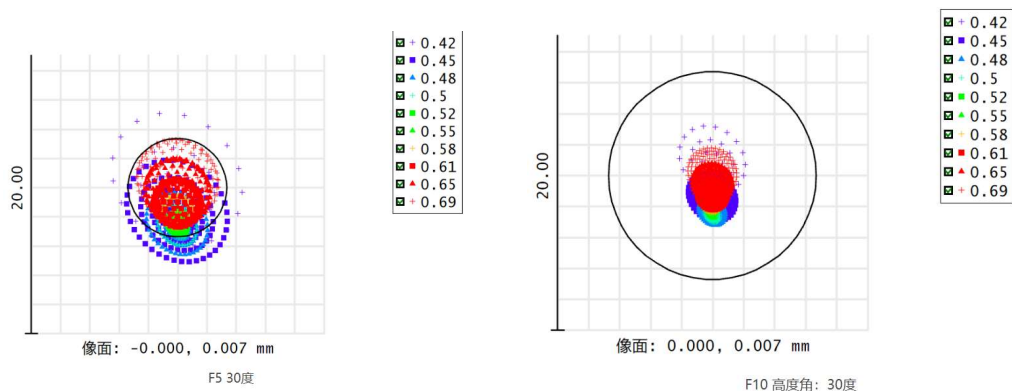
It is recommended to view the tilt after photographing stack sharpen hundreds of frames, compensate appropriately according to the tilt degree, or use the ADC alignment assist in sharpcap 4.0 or newer.

## Installation :

Since the core of eADC is the optical device composed of four prisms, the flat glass composed of four prisms will introduce chromatic aberration and spherical aberration. This effect is negligible for F10 and slower telescopes. But if it is a mirror larger than F10, such as F7, F5, F4 and other faster telescopes have a certain impact on the imaging, it is recommended to add it behind the focus expander .

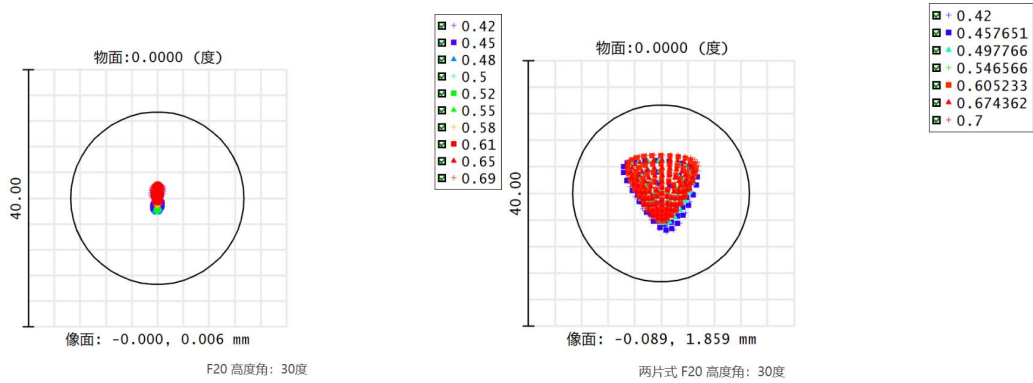
When the camera is directly connected to the eADC, if possible, try to keep the sensor chip away from the prism of the eADC. If it is too close to the prism, it is possible that the maximum compensation of the prism can not correct the atmospheric dispersion.. And if the distance is too close, the dust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

The following figure shows that at the focal ratio of F5, due to the difference of refractive index at different wavelengths, different wavelengths are out of focus, and dispersion is introduced. When the focal length is extended to F10, the chromatic aberration and spherical aberration are reduced to a negligible degree. Therefore, it is suggested that in the fast focal ratio system, the focus extender should be added in front of the ADC to slow down the focal ratio of the light passing through the prism, which can improve the imaging quality.



Comparison of the spot diagrams of the four pieces ADC at focal ratios F5 and F10

Since the incident angles of light at different positions are very close, the four-chip ADC can have a smaller circle of confusion than the two-chip ADC. This results in higher imaging quality.



Four pieces ADC at F20

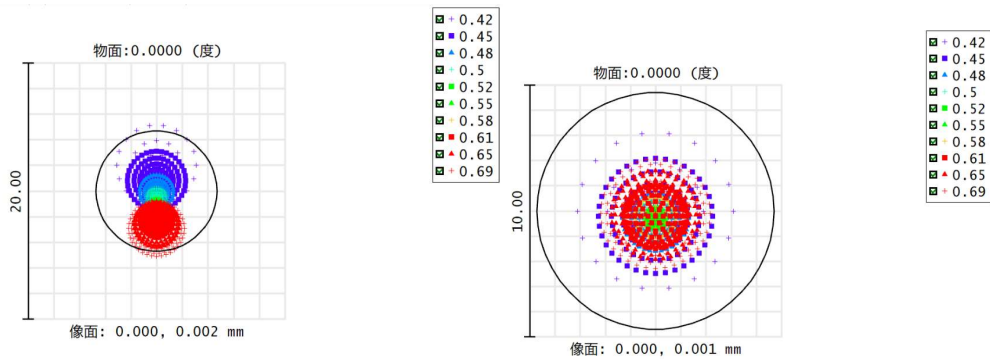
Two pieces ADC at F20

### Zero image shift ADC compare to ADC

Since the compensation of ADC is not infinite, ADC has its limit compensation angle. Generally, in a 12-inch F20 system, the lowest compensation angle is about 10 degrees. If you need to give sufficient compensation to targets with lower angles, the distance between the sensor or eyepiece and the ADC lens should be increased to obtain a lower angle of chromatic aberration compensation.

## Maximum use altitude angle

ADC has not only the lowest use angle limit, but also the highest use angle limit. Ideally, the light should be incident perpendicular to the lens. In fact, due to processing and assembly limitations, it is unrealistic to always let the light incident perpendicularly. Therefore, the light will be incident at a certain angle, which causes the ADC to still produce slight chromatic aberration even at 0 position. That is to say, at 0 position, it will still compensate for a certain altitude angle. If it is greater than this altitude angle, it will have a counter-effect, introducing chromatic aberration and thus reducing the system resolution. The maximum use altitude of this ADC is about 82 degrees. Above 82 degrees, it will not compensate for atmospheric chromatic aberration, but will produce chromatic aberration. It is recommended to remove the ADC for applications above 82 degrees

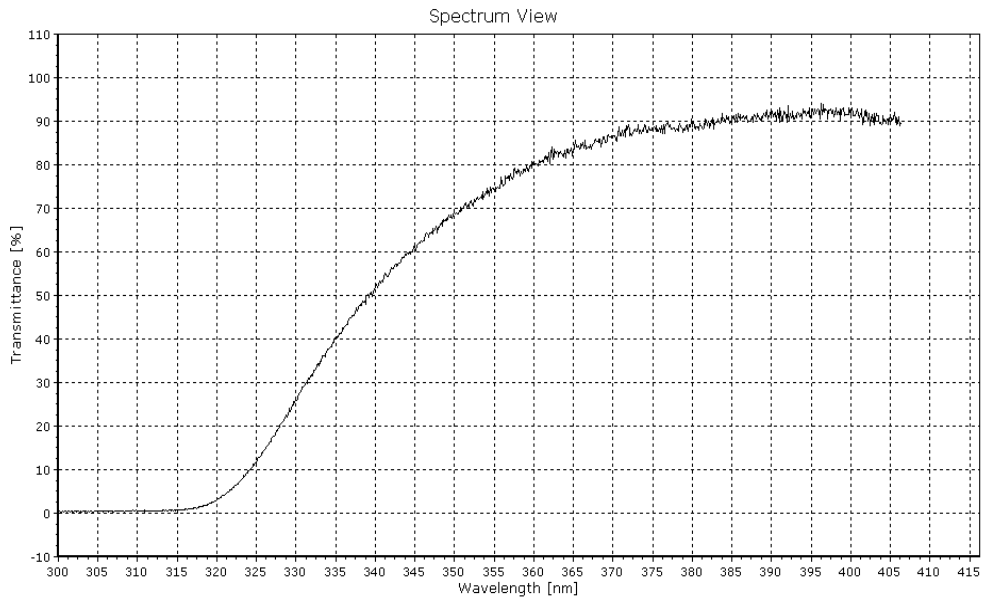


F7 at 90 degrees

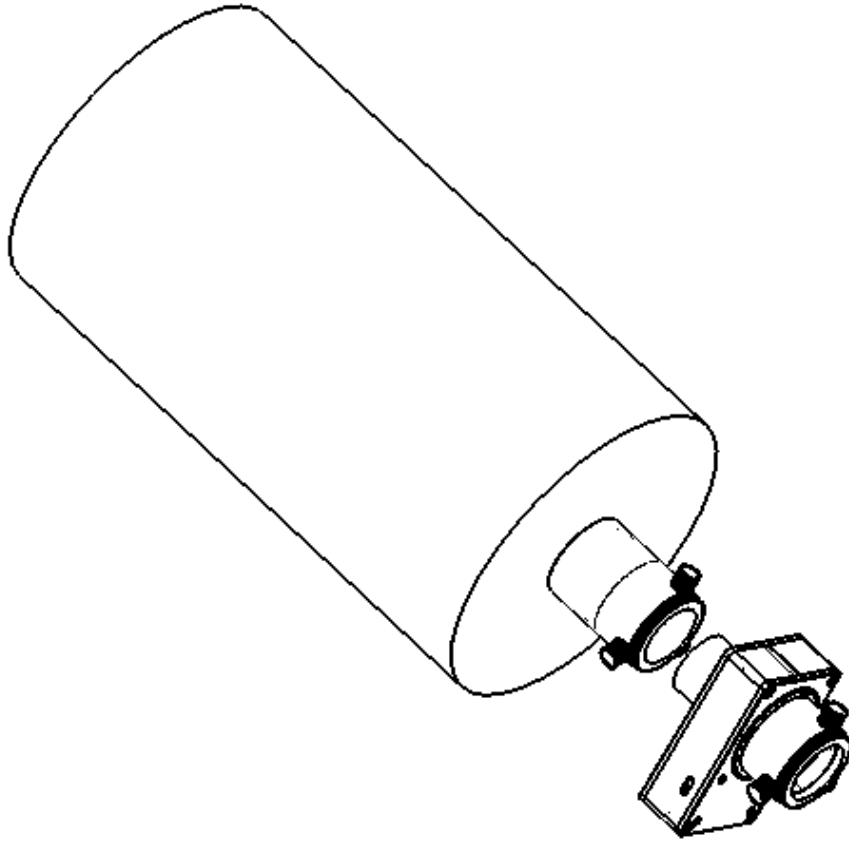
F7 at 82 degrees



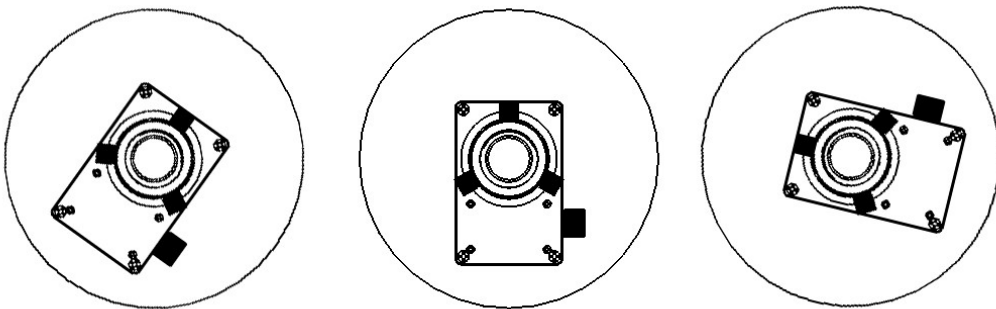
The four-piece eADC coating is 350-700nm anti-reflection. Because the material used contains ultraviolet absorption material and the correction error becomes larger in the ultraviolet band, it is not recommended to use it in the band below 400nm.



ADC system transmittance curve 300nm-400nm

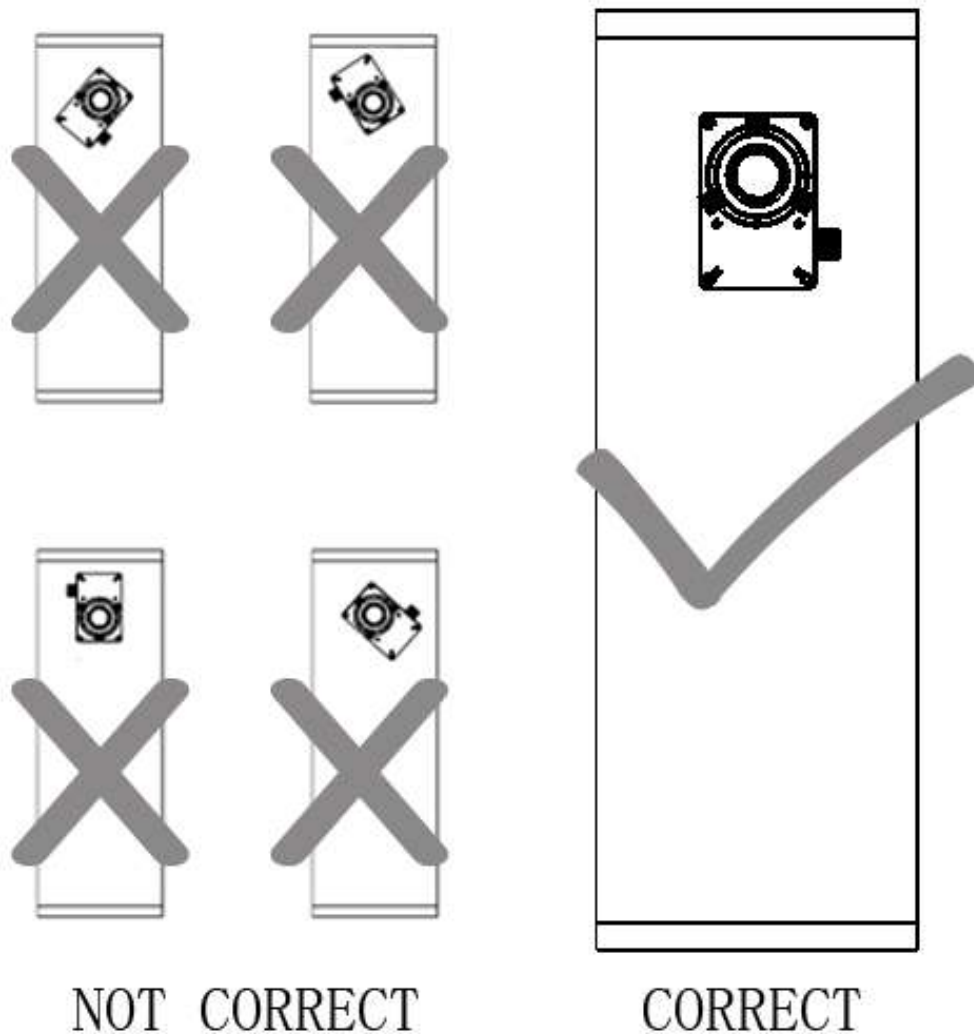


Mode0:Installation diagram of mode 0



eADC work in mode 0,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 the installation has no requirements on the angle . The eADC can be installed at any angle around the optical axis, and the eADC will automatically correct according to the tilt angle.



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

**Mode 1:** The eADC work on Newton reflection telescope should work in mode 1. When the eADC in mode 1, the installation angle is required. It is required that the longest side of the shell of the eADC should be parallel to the optical axis (or geometric centerline) of the Newton reflection telescope . Because the human eye cannot accurately judge, a small error is allowed. The calibration error caused by this error 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 of 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 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 the 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.

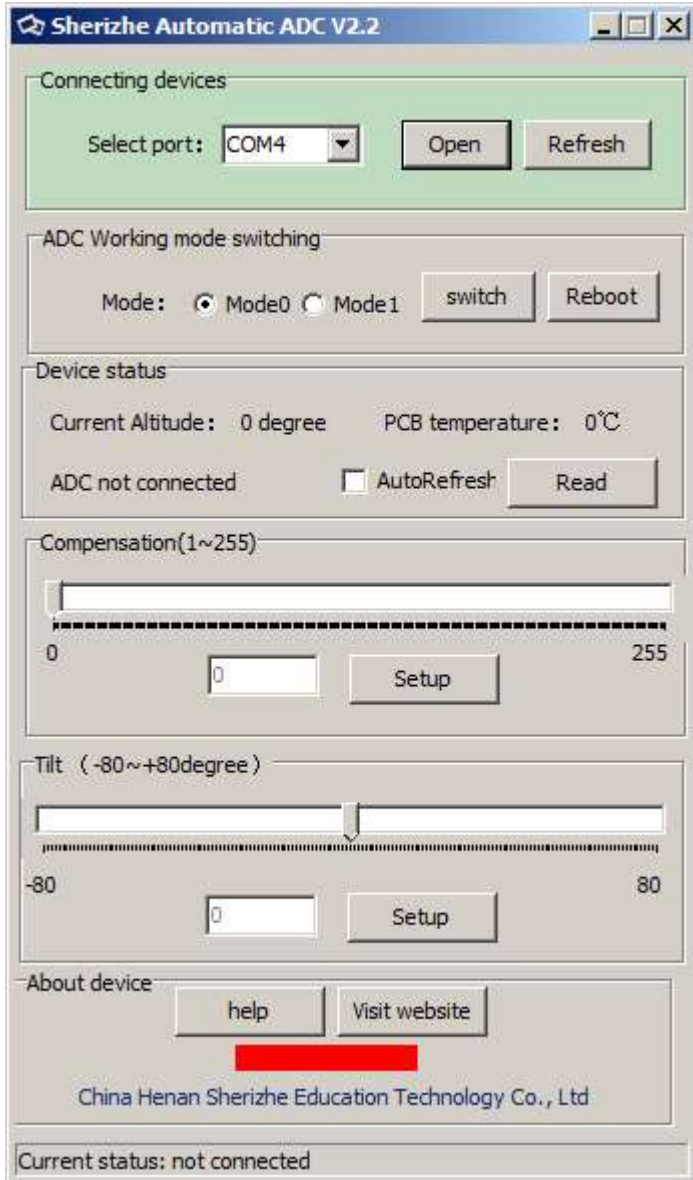
Open the computer software of the SUNOBSERVER electric eADC, select the port - COM6 (the actual port number is subject to the actual computer identification port number, here take COM6 as an example) - click Connect - the status bar at the bottom of the window changes to connect to com6 to set the parameters.

If there is no recognized virtual serial port in the port bar, click the refresh button, or you should right mouse bottom use administrator run the software.

eADC Working mode switching: select the working mode you need and click switching. The eADC will automatically restart and initialize after 4 seconds later. Do not click the restart button before automatic restart, otherwise the setting fails.

The equipment status displays the current working elevation and working temperature. After clicking the read button, the current working elevation, current working temperature, compensation and tilt compensation will be read and displayed in the interface. If auto refresh is select, the parameters will be updated once every 4 seconds. Because of mechanical installation error and other factors, the elevation angle is only for reference only. Because the circuit board has self heating, the current working temperature is for reference only.

Drag the slider with the mouse to set the dispersion compensation amount and horizontal tilt compensation angle. 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 setting button to write the parameters into the device.





Send:Mode1# Return:Mode1\*

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

### **Command 3 :Ti+DD#**

The horizontal tilt of electric eADC is compensated clockwise, DD represents 2 digits, and the digital 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. Indicates 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.

Such as:

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

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

### **Command 4 :Ti-DD#**

Electric eADC horizontal tilt counterclockwise compensation, DD represents 2 digits, and the digital 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. Indicates 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.

Such as:

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

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

### **Command 5 :Reset#**

The system restart command, the system restarts immediately after sending.

### **Command 6 :GetAl#**

Send a request to obtain the current status data of the system.

Read the current PCB temperature, current elevation, current compensation coefficient, current working mode and current inclination compensation.

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

### Return data string definition

Date bit	Content	Definition	Conversion
0	0x3A	Start 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	End character	ASII value of character *

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

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



Commands table

Command	Return value	Fuction	Value range
:CoDDD#	:CoDDD*	Set dispersion compensation	1-999
:ModeD#	:ModeD*	Set eADC operating 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	