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苏州振旺光电

赤道仪通信协议

ZWO Mount Serial Communication Protocol

版本	说明	日期
V1.0	初版	2022/7/11
V1.0	Original edition	2022/7/11

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● **通信连接说明**

客户端使用串口连接赤道仪时，通信波特率为 9600

客户端通过手柄的 WIFI AP 网络连接赤道仪时，连接 IP:192.168.4.1,PORT:4030

About the connection

Communication to the mount via serial cable is 9600.
Wireless communication to the mount via the WIFI of the hand controller: IP 192.168.4.1, PORT 4030.

● **通信协议说明**

协议基于 LX200 并且兼容 LX200

About the Protocol

The Protocol is based on LX200 also compatible with LX200.

协议规则如下：

命令格式以":"开头，中间是命令码，以"#"结尾，如":AA#".

Commands usually start with ":" and end with "#", such as ":AA#". Fields in the middle represent the command itself.

命令码格式 Command format			
起始字符	命令码	结束字符	
Starting character	Command Code	Ending character	
:	nnn	#	n 表示一个字符,命令码不超过 62 字节
:	nnn	#	N represents one character. The whole length of a command code does not exceed 62 characters.

命令返回格式 Command response format					
移动命令或者非法命令	设置参数命令	GOTO 命令	获取跟踪状态命令	获取参数命令	同步命令
Moving Command or Illegal Command	Configuring Settings Command	GOTO Command	Getting Tracking Status command	Getting Current Settings command	Sync Command
无返回	1：正确 0：错误	0 成功 e+错误码#	0# 跟踪未开启 1# 跟踪进行中 e+错误码#	以#结尾的字符串 例如： sDD*MM:SS#	N/A# e+错误码#
No response	1: Success 0: False	0 Success e+ error code	0# Tracking off 1# Tracking on e+ error code	Strings ended with #,	N/A# e+ error code

				such as : sDD*MM:SS#	

下文中出现下面的字符为通配符

Characters below are wildcards.

通配符 Wildcard	说明 Statement	举例 Example
s	+或者- + or -	:SGsHH#（:SG-08#）
HH:MM:SS	小时:分钟:秒 Hour:Minute:Second	:SLHH:MM:SS# (:SL19:44:32#)
MM/DD/YY	月份/日/年 Month/Date/Year	:SCMM/DD/YY# (:SC06/08/22#)
n	数字 Number	:Rn# (:R9#)
x	字母或者数字 Letter or number	xxx# (78e36d441524#)
&	分割多个参数 Separete multiple parameters	MM/DD/YY&HH:MM:SS&sHH:MM#

命令返回值分 4 种情况

There are 4 kinds of command response values.

1）无返回。某些命令不需要返回值，例如移动指令。

2）返回 0，或 1。该返回用来表示命令指向成功或失败，GOTO 命令使用 0 表示成功，其他命令使用 1 表示成功。

3）返回 0，或 1，e+错误码+#，如 e1#，数字 1 代码错误码，可以在下面错误码说明查看具体原因。

4）返回字符串+#结尾。如 HH:MM:SS#，该返回用来返回数据。

5）返回 N/A#或者 e+错误码# (同步命令)

注意：以 G 开头的获取命令，返回值都会带有#

1) No response. Some commands do not require response values, such as moving commands.
2) Response 0 or 1. It stands for success or failure of the command. Success for GOTO commands is 0, for other commands is 1.
3) Response 0 or 1 or e+ error code+#. For example, e1#, the number 1 stands for error code. You can check the explanation below to see the reason.
4) Response character string ends with +#. For example, HH:MM:SS#, it was used to response data.
5) Response N/A# or e+ error code# (Sync commands).
Note: The response values of Get Commands starting with G all comes with #.

错误码说明：

Error code statement:

错误码	说明	Statement
1	参数超出范围	Parameter beyond the range
2	参数格式错误	Parameter format error
3	在归零，slew，goto 的状态时，执行 GOTO 会返回该错误码	When the mount is going to the zero position, or slewing or doing GOTO, carrying out GOTO will response this error code.
4	设备正在移动中	Equipment moving

5	目标低于地平线	Target under horizon line
6	目标低于高度限制	Target under height limitation
7	未同步时间地点	Time and position not synchronized
8	跟踪过了中天	Meridian has been passed over in tracking

● 赤道仪/经纬仪切换命令

命令：":AP#"

返回：None

说明：切换到赤道仪模式

命令：":AA#"

返回：None

说明：切换到经纬仪模式

注意：切换模式后，需要重启赤道仪

Equatorial/Altazimuth mode switching command

Command: ":AP#"
Response: None
Statement: Switch to Equatorial mode

Command: ":AA#"
Response: None
Statement: Switch to Altazimuth mode
Note: You need to reboot the mount after mode switched.

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● 日期和时间命令

注意：连接上赤道仪后，需要先设置经纬度，时区，本地时间后，赤道仪才可以正常工作。

Date/time command

Note: You need to set the longitude and latitude, time zone and local time after the mount is turned on to ensure it can work properly.

命令： ":SCMM/DD/YY#"

返回： "1：正确，0：错误"

说明：设置日期

Command: ":SCMM/DD/YY#"
Response: "1: Success, 0: False"
Statement: Set date.

命令： ":GC#"

返回： "MM/DD/YY#"

说明：获取日期

Command: ":GC#"
Response: "MM/DD/YY#"
Statement: Get date.

命令： ":SLHH:MM:SS#"

返回： "1：正确，0：错误"

说明：设置时间

Command: ":SLHH:MM:SS#"
Response: "1: Success, 0: False"
Statement: Set time.

命令： ":GL#"

返回："HH:MM:SS#"

说明：获取时间

Command: ":GL#"
Response: "HH:MM:SS"
Statement: Get time.

命令： ":GS#"

返回： "HH:MM:SS#"

说明：获取恒星时

Command: ":GS#"
Response: "HH:MM:SS#"
Statement: Get sidereal time.

命令： ":GH#"

返回： "1：夏令时开启，0：夏令时未开启"

说明：获取夏令时配置信息

Command: ":GH#"
Response: "1: Summer time on, 0: Summer time off"
Statement: Get the Summer time setting.

命令： ":SHn#"

返回： "1"

说明：配置夏令时，n 取值范围为 0-1；0 代表关闭夏令时，1 代表打开夏令时

Command: ":SHn#"
Response: "1"
Statement: Set Summer time. n's value: 0~1; 0 stands for turning off Summer time. 1 stands for turning on Summer time.

● **位置坐标命令**

命令： ":SGsHH#"

返回： "1：正确，0：错误"

说明：设置时区（小时），小写字母 s 代表符号（-/+），东八区设置为

SG-08#，西区反而是正的

Position/coordinates commands:

Command: ":SGsHH#"

Response: "1: Success，0: False"

Statement: Set time zone (hour). The lowercase s indicates symbol (-/+). UTC +8 is set to SG-08#. The western time zones use negative offset.

命令： ":SGsHH:MM#"

返回： "1：正确，0：错误"

说明：设置时区（小时:分钟），同上一个命令基本一样，增加了分钟设置，目的是支持一些

非整数时区的国家，比如印度 UTC+5:30

Command: ":SGsHH:MM#"

Response: "1: Success，0: False"

Statement: Set time zone (hour: minute). This command is basically the same as last command, but with an extra minute setting for countries like India whose time zone is UTC +5:30.

命令： ":GG#"

返回： "sHH:MM#"

说明：获取时区

Command: ":GG#"
Response: "sHH:MM"
Statement: Get time zone.

命令： ":StsDD*MM:SS#"

返回："1：正确，0：错误"

说明：设置纬度，小写字母 s 代表符号（-/+），例如：设置北纬 31°15'24'' （:St+31*15:24#）

Command: ":StsDD*MM:SS#"

Response: "1: Success，0: False"

Statement: Set latitude. The lowercase s indicates symbol (-/+), for example: N 31°15'24''(:St+31*15:24#).

命令：":Gt#"

返回："sDD*MM:SS#"

说明：获取纬度

Command: ":Gt#"
Response: "sDD*MM#"
Statement: Get latitude.

命令：":SgsDDD*MM:SS#"

返回："1：正确，0：错误"

说明：设置经度，小写字母 s 代表符号（-/+），DDD (000°-180°)，MM (00'-59')，SS（秒值：0-59)

Command: ":SgsDDD*MM:SS#"

Response: "1: Success，0: False"

Statement: Set longitude. The lowercase s indicates symbol (-/+). DDD (000°-180°), MM (00'-59'), SS (Second: 0-59).

命令：":Gg#"

返回："sDDD*MM:SS#"

说明：获取经度

Command: ":Gg#"
Response: "sDDD*MM#"
Statement: Get longitude.

命令：":Gm#"

返回："E(东)，W(西)，N(无朝向，即零位)"

说明：获取赤道仪朝向

Command: ":Gm#"
Response: "E(East), W(West), N(No direction. Home/zero position)"
Statement: Get the current cardinal direction of the mount.

● **移动命令**

命令：":SrHH:MM:SS#"

返回："1：正确，0：错误"

说明：设置目标 RA

Moving commands:

Command: ":SrHH:MM:SS#"

Response: "1: Success，e2#: False"

Statement: Set target RA

命令：":Gr#"

返回："HH:MM:SS#"

说明：获取目标 RA

Command: ":Gr#"
Response: "HH:MM:SS#"
Statement: Get target RA

命令：":SdsDD:MM:SS#"

返回："1：正确，0：错误"

说明：设置目标 DEC，小写字母 s 代表符号（-/+），DD (代表多少度)，MM (代表角分，1 度 =

60 角分)，SS (代表角秒，1 角分 = 60 角秒)

Command: ":SdsDD:MM:SS#"

Response: "1: Success，e2#: False"

Statement: Set target DEC. The lowercase s indicates symbol (-/+). DD indicates degree. MM indicates arcminute (1° = 60 arcminutes). SS indicates arcsecond (1 arcminute = 60 arcseconds).

命令：":Gd#"

返回："sDD*MM:SS#"

说明：获取目标 DEC

Command: ":Gd#"
Response: "sDD*MM:SS#"
Statement: Get target DEC

命令：":GR#"

返回："HH:MM:SS#"

说明：获取当前 RA

Command: ":GR#"
Response: "HH:MM:SS#"
Statement: Get current RA of mount.

命令：":GD#"

返回："sDD*MM:SS#"

说明：获取当前 DEC

Command: ":GD#"
Response: "sDD*MM:SS#"
Statement: Get current DEC of mount.

命令：":GZ#"

返回："DDD*MM:SS#"

说明：获取方位角

Command: ":GZ#"

Response: "DDD*MM:SS#"
Statement: Get Azimuth

命令："：GA#"

返回："sDD*MM:SS#"

说明：获取高度角

Command: ":GA#"
Response: "sDD*MM:SS#"
Statement: Get altitude

命令："：MS#"

返回："0：正确，e+错误码+#"

说明：GOTO

注意：必须同步过时间地点后才可以进行 GOTO，在归零，slew，goto 的状态时发送 GOTO 指令会返回 e3#。

Command: ":MS#"

Response: "1: Success，e2#: False"

Statement: GOTO
Note: The mount will not be able to GOTO before time and position get synchronized. When it is going to zero position, or slewing, or doing GOTO, sending the GOTO command will response e3#.

命令："：Q#"

返回：None

说明：停止运动

Command: ":Q#"
Response: None
Statement: Stop moving.

命令："：Rn#"

返回：None

说明：设置移动速度，n 代表速度等级，从 0 到 9，代表 0.25, 0.5, 1, 2，4, 8, 20, 60, 720, 1440

倍恒星速

Command: ":Rn#"
Response: None
Statement: Set moving speed. n indicates speed level; The range 0 – 9 stands for 0.25x, 0.5x, 1x, 2x, 4x, 8x, 20x, 60x, 720x and 1440x sidereal tracking rate.

命令："RG#"

返回：None

说明：设置移动速度为 0.5 倍恒星速（对应 R1)

Command: ":RG#"
Response: None
Statement: Set the moving speed to 0.5x sidereal tracking rate (R1).

命令："RC#"

返回：None

说明：设置移动速度为 1 倍恒星速（对应 R2)

Command: ":RC#"
Response: None
Statement: Set the moving speed to 1x sidereal tracking rate (R2).

命令："RM#"

返回：None

说明：设置移动速度为 720 倍恒星速（对应 R8)

Command: ":RM#"
Response: None
Statement: Set the moving speed to 720x sidereal tracking rate (R8).

命令："RS#"

返回：None

说明：设置移动速度为 1440 倍恒星速（对应 R9）

Command: ":RS#"
Response: None
Statement: Set the moving speed to 1440x sidereal tracking rate (R9).

命令： ":Rvnnnn.nn#"

返回：None

说明：设置移动速度，nnnn.nn 代表 0.00-1440.00 之间的恒星速，可以取 2 位小数

Command: ":Rvnnnn.nn#"
Response: None
Statement: Set the moving speed. nnnn.nn stands for sidereal tracking rate between 0.00 ~ 1440.00. The figure is accurate to two decimal places.

命令： ":Me#"

返回：None

说明：向东移动（移动前必须设置速度）

Command: ":Me#"
Response: None
Statement: Move towards east (You should set moving speed before it actually moves).

命令： ":Qe#"

返回：None

说明：停止向东移动

Command: ":Qe#"
Response: None
Statement: Stop moving towards east.

命令： ":Mw#"

返回：None

说明：向西移动（移动前必须设置速度）

Command: ":Mw#"
Response: None
Statement: Move towards west (You should set moving speed before it actually moves).

命令：":Qw#"

返回：None

说明：停止向西移动

Command: ":Qw#"
Response: None
Statement: Stop moving towards west.

命令：":Mn#"

返回：None

说明：向北移动（移动前必须设置速度）

Command: ":Mn#"
Response: None
Statement: Move towards north (You should set moving speed before it actually moves).

命令：":Qn#"

返回：None

说明：停止向北移动

Command: ":Qn#"
Response: None
Statement: Stop moving towards north.

命令：":Ms#"

返回：None

说明：向南移动（移动前必须设置速度）

Command: ":Ms#"
Response: None
Statement: Move towards south (You should set moving speed before it actually moves).

命令： ":Qs#"

返回：None

说明：停止向南移动

Command: ":Qs#"
Response: None
Statement: Stop moving towards south.

● **跟踪和导星命令**

命令： ":TQ#"

返回：None

说明：使用恒星速跟踪

Tracking/guiding command
Command: ":TQ#"
Response: None
Statement: Use sidereal tracking rate.

命令： ":TS#"

返回：None

说明：使用太阳速跟踪

Command: ":TS#"
Response: None
Statement: Use solar tracking rate.

命令： ":TL#"

返回：None

说明：使用月亮速跟踪

Command: ":TL#"
Response: None
Statement: Use lunar tracking rate.

命令："":GT#"

返回：""0#，1#，2#"

说明：获取跟踪速度（0：恒星速，1：月亮速，2：太阳速）

Command: ":GT#"

Response: "1#，2#，3#"

Statement: Get tracking rate (0: Sidereal rate, 1: Solar rate, 2: Lunar rate).

命令："":Te#"

返回："1：正确，0：错误"

说明：开始跟踪

注意：返回失败可以通过:GAT#命令来获取跟踪失败原因

Command: ":Te#"
Response: "1: Success, 0: False"
Statement: Start tracking.
Note: If failed in starting tracking, you can get the failure reason through command :GAT#.

命令："":Td#"

返回："1：正确，0：错误"

说明：停止跟踪

注意：在归零，slew，goto 的状态下会返回失败

Command: ":Te#"
Response: "1: Success, 0: False"

Statement: Stop tracking.
Note: It will fail stop tracking when the mount is going to zero position, slewing and doing GOTO.

命令：":GAT#"
返回："0# 跟踪未开启，1# 跟踪进行中，e+错误码+#"
说明：获取跟踪状态
注意：
跟踪打开情形：打开跟踪，GOTO 到位
跟踪正常关闭情形：关闭跟踪，归零
跟踪异常关闭情形：跟踪低于地平线，跟踪过中天（赤道仪），没有同步时间地点（经纬仪）
Command: ":GAT#"
Response: "0# tracking off, 1# tracking on, e+ error code+#"
Statement: Get tracking status.
Note: Conditions of tracking on – It has already been turned on manually; Successfully GOTO target.
Normal conditions of tracking off – It has already been turned off manually; Mount in zero position.
Abnormal conditions of tracking off – Target below the horizon line; Meridian has been passed over in tracking; Time and position are not synchronized (Altazimuth mount).

命令：":Mgdnnnn#"

返回：None

说明：导星，d (e\w\s\n) 代表方向东、西、南、北 nnnn (0000-3000) 代表导星时间，单位 ms
Command: ":Mgdnnnn#"
Response: None
Statement: Guiding. d (e\w\s\n) indicates direction east, west, south, north. nnnn (0000-3000) indicates guiding rate (unit: ms).

命令：":Rg0.nn#"

返回：None

说明：设置导星速度,数值范围为 0.10-0.90
Command: ":Rg0.nn#"
Response: None
Statement: Set guiding rate from 0.10 to 0.90.

命令： ":Ggr#"

返回： "0.nn#"

说明：获取跟踪速度（0：恒星速，1：月亮速，2：太阳速）

注意: 数值范围为 0.10 - 0.90，代表 0.1x-0.9x 的跟踪速度

Command: ":Ggr#"
Response: 0.nn#
Statement: Get tracking rate (0: Sidereal rate, 1: Solar rate, 2: Lunar rate).

● **同步命令**

命令： ":CM#"

返回： "N/A#：成功，e+错误码#"

说明：同步位置（需要先设置目标 RA 和 DEC）

Sync commands:

Command: ":CM#"

Response: "N/A#：Success，e2#: Error"

Statement: Synchronization. It requires you to set target RA and DEC first.

● **归零命令**

命令： ":hC#"

返回：None

说明：RA 和 DEC 归零位（机械归零）

Zero/home position command:

Command: ":hC#"
Response: None
Statement: Stop at zero position (Both RA and DEC).

● **复合命令**

命令： ":SMGEsDD*MM:SS&sDDD*MM:SS#"

返回： "1：正确，0：错误"

说明：设置纬度，经度

Compound commands:

Command: ":SMTIMM/DD/YY&HH:MM:SS&sHH:MM#"
Response: "1: Success, 0: False"
Statement: Set latitude and longitude.

命令： ":GMGE#"

返回： "sDD*MM:SS&sDDD*MM:SS#"

说明：获取纬度，经度

Command: ":GMGE#"
Response: "sDD*MM&sDDD*MM#"
Statement: Get longitude and latitude.

命令： ":SMTIMM/DD/YY&HH:MM:SS&sHH:MM#"

返回： "1：正确，0：错误"

说明：设置日期，时间，时区

Command: ":SMTIMM/DD/YY&HH:MM:SS&sHH:MM#"
Response: "1: Success, 0: False"
Statement: Set date, time and time zone.

命令： ":GMTI#"

返回： "MM/DD/YY&HH:MM:SS&sHH:MM#"

说明：获取日期，时间，时区

Command: ":GMTI#"
Response: "MM/DD/YY&HH:MM:SS&sHH:MM#"
Statement: Get date, time and time zone.

命令：":GMeq#"

返回："HH:MM:SS&sDD*MM:SS#"

说明：获取目标 RA，目标 DEC

Command: ":GMeq#"
Response: "HH:MM:SS&sDD*MM:SS#"
Statement: Get target RA and DEC.

命令：":GMEQ#"

返回："HH:MM:SS&sDD*MM:SS#"

说明：获取 RA，DEC

Command: ":GMEQ#"
Response: "HH:MM:SS&sDD*MM:SS#"
Statement: Get the current RA/DEC coordinates.

命令：":GMZA#"

返回："DDD*MM:SS&sDD*MM:SS#"

说明：获取方位角，高度角

Command: ":GMZA#"
Response: "DDD*MM:SS&sDD*MM:SS#"
Statement: Get Azimuth/altitude.

命令：":SMeqHH:MM:SS&sDD*MM:SS#"

返回："0：正确，e+错误码+#"

说明：设置目标 RA，目标 DEC，并进行 GOTO

注意：必须同步过时间地点后才可以进行 GOTO，在归零，slew，goto 的状态时发送 GOTO 指

令会返回 e3#。

Command: ":SMeqHH:MM:SS&sDD*MM:SS#"
Response: "0: Success, e+ error code+#"

Statement: Set target RA and DEC and GOTO.

Note: The mount will not be able to GOTO before time and position get synchronized. When it is going to zero position, or slewing, or doing GOTO, sending the GOTO command will response e3#.
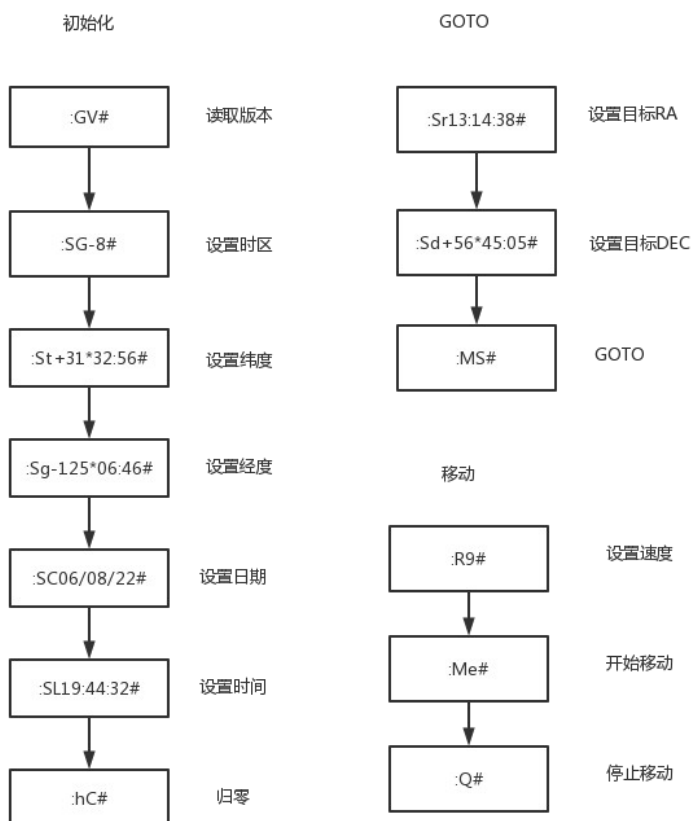
命令： ":SMMCHH:MM:SS&sDD*MM:SS#"

返回： "N/A#：成功，e+错误码#"

说明：设置目标 RA 和 DEC,并且同步位置

Command: ":SMMCHH:MM:SS&sDD*MM:SS#"
Response: "N/A#: Success, e+ error code+#"
Statement: Set target RA and DEC and sync position.

● 使用流程举例

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初始化                          GOTO

┌─────────┐                    ┌──────────────┐
│  :GV#   │ 读取版本           │ :Sr13:14:38# │ 设置目标RA
└─────────┘                    └──────────────┘
     │                                │
     ▼                                ▼
┌─────────┐                    ┌──────────────┐
│ :SG-8#  │ 设置时区           │ :Sd+56*45:05#│ 设置目标DEC
└─────────┘                    └──────────────┘
     │                                │
     ▼                                ▼
┌──────────────┐                ┌──────────────┐
│ :St+31*32:56#│ 设置纬度       │    :MS#      │ GOTO
└──────────────┘                └──────────────┘
     │
     ▼
┌───────────────┐              移动
│ :Sg-125*06:46#│ 设置经度
└───────────────┘              ┌─────────┐
     │                         │  :R9#   │ 设置速度
     ▼                         └─────────┘
┌──────────────┐                    │
│ :SC06/08/22# │ 设置日期            ▼
└──────────────┘               ┌─────────┐
     │                         │  :Me#   │ 开始移动
     ▼                         └─────────┘
┌──────────────┐                    │
│ :SL19:44:32# │ 设置时间            ▼
└──────────────┘               ┌─────────┐
     │                         │  :Q#    │ 停止移动
     ▼                         └─────────┘
┌─────────┐
│  :hC#   │ 归零
└─────────┘
```

Procedure example:

Initialization
Set time zone
Set latitude
Set longitude
Set date
Set time
Go to zero position

GOTO
Set target RA
Set target DEC
GOTO

Move
Set speed
Start moving
Stop moving