COFDM module parameter configuration instructions

Version 2.2

Version update record:

Version	Update date	describe
1.0	2016-10-24	initial version
1.1	2016-11-1	ATDR reply differentiation module
1.2	2016-12-26	ATSE and ATGE add audio switches
1.3	2017-2-14	Add ATSP protocol
1.4	2017-2-28	Add ATST and ATGT protocols
1.5	2017-3-27	ATGE instruction adds AES status acquisition
1.6	2017-4-19	Add ATGB protocol
1.7	2017-5-18	Add AV and HDMI output control to the receiving end
1.8	2017-9-12	Supports obtaining the current AV output format
1.9	2018-3-15	Added ATSU and ATGU instructions
2.0	2019-6-25	Added ATOSD, ATSIP, ATGIP instructions
2.1	2020-3-23	Modify ATSE and ATSR instructions
		Added ATSTS and ATGTS instructions
2.2	2023-11-22	Added ATSAI and ATGAI commands
		Added ATSAE and ATGAE instructions
		Add ATSF command

When using our COFDM transceiver module, users may need to modify the configuration parameters of the module. In order to simplify the user's operation, we design the parameter configuration into a few simple AT commands. The user only needs to use the specified AT command and pass the corresponding parameters to complete the parameter setting of the COFDM module.

1.1 Command introduction

The AT command to configure COFDM module parameters starts with "AT" and ends with an underscore "_". Each AT command has several or no parameters, and each AT command has a return value. Please see the introduction of the following commands for details.

Users can configure the serial port of the COFDM module (TTL level, 3.3V) and Configure the parameters of the module. For detailed serial port configuration, refer to the figure below. Please use "Serial port debugging assistant" and other tools to send AT commands to the COFDM module, pay attention to use text mode, For example:
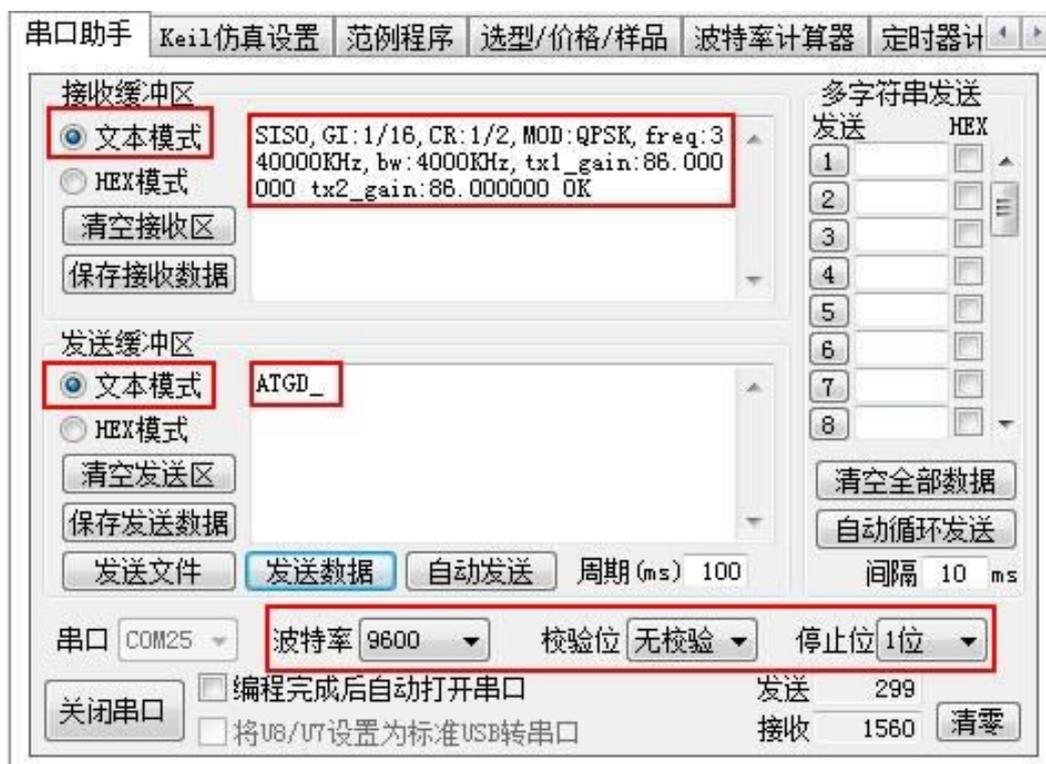
1.2 Command classification

AT commands for configuring COFDM module parameters are mainly divided into the following two categories:

Query command	ATDR、ATGD、ATGE、ATGI、ATGR、ATGT、ATGB、ATGU、ATGIP、ATGTS、ATGAI、ATGAE
Setup instructions	ATSD、ATSF、ATSG、ATSM、ATSE、ATSI、ATSO、ATSR、ATSP、ATST、ATSU、ATOSD、ATSIP、ATSTS、ATSAI、ATSAE

From the perspective of whether to save when power is off, the setting command can be divided into:

Power-off save command	ATSD、ATSE、ATSI、ATSO、ATSR、ATSP、ATST、ATSU、ATSIP、ATSTS、ATSAI、ATSAE
Commands are not saved when power is off	ATSF、ATSG、ATSM、ATOSD

According to configuration objects, the classification is as follows:

Sender configuration command	ATDR、ATSD、ATGD、ATSF、ATSG、ATSM、ATSE、ATGE、ATSI、ATGI、ATSO、ATSP、ATST、ATGT、ATSU、ATGU、ATOSD、ATSTS、ATSAI、ATGAI、ATSAE、ATGAE
Receiver configuration command	ATDR、ATSR、ATGR、ATSP、ATST、ATGT、ATGB、ATSIP、ATGIP、ATSTS

1.3 Command details

1.3.1 ping command

Format	**ATDR_**
parameter	none
use	Used for integrated systems to do device self-tests and identify connected modules.
return value	Transmitter returns the "device profile" string
	Receiver-SUE1 returns "ATDRSUE1 OK" string
	Receiver-SHD1 returns "ATDRSHD1 OK" string
Remark	Query command

1.3.2 set device command

Format	**ATSD$(mimo), $(gi), $(code_rate), $(constellation), $(freq(KHz)), $(bw(KHz)), $(tx1_gain), $(tx2_gain)_** For example: ATSD0,1,0,0,800000,8000,86.0,86.0_
parameter	Single antenna/dual antenna mimo: 0 mimo disable; 1 mimo enable
	Guard interval GI: 0 1/32; 1 1/16; 2 1/8; 3 1/4
	Convolution code rate code rate: 0 1/2; 1 2/3; 2 3/4; 3 5/6; 4 7/8;
	Constellation constellation: 0 QPSK; 1 QAM16; 2 QAM64;
	Transmitter carrier center frequency freq (KHz) 70000~3000000 (70MHz~3GHz, 1KHz step)
	Transmitter channel bandwidth bw (KHz) 2000~8000 (2MHz~8MHz, 1KHz step)
	Transmitting antenna 1 gain tx1_gain 0.0~89.75dB, 0.25dB step
	Turn off antenna 2 gain tx2_gain 0.0~89.75dB, 0.25dB step
use	Used to set various parameters of the device (sender)
return value	For example: ATSD0,1,0,0,800000,8000,86.0,86.0_ SISO,GI:1/16,CR:1/2,MOD:QPSK,freq:800000KHz,bw:8000KHz,tx1_gain:86.000000 tx2_gain:86.000000 OK
Remark	Set the command and save it after power off. Data rate calculation formulas corresponding to different bandwidths, guard intervals, convolutional code rates, and constellations Air interface rate Rate(MBps) = (BandWidth(MHz) * 8.0/7.0) / (1+GI) * 1512/2048*log2(constellation point) * code_rate * 188/204. Taking 8MHz bandwidth as an example, different guard intervals, convolutional code rates, constellation corresponding data rates, and required receiving signal-to-noise ratios

Constel-lation	Code rate	Required C/N (dB) for BER = 2 x 10^{-4} after Viterbi QEF after Reed-Solomon (see note 2)			Bitrate (Mbit/s) (see note 3)			
		Gaussian Channel (AWGN)	Ricean channel (F₁)	Rayleigh channel (P₁)	Δ/T_U = 1/4	Δ/T_U = 1/8	Δ/T_U = 1/16	Δ/T_U = 1/32
QPSK	1/2	3,5	4,1	5,9	4,98	5,53	5,85	6,03
QPSK	2/3	5,3	6,1	9,6	6,64	7,37	7,81	8,04
QPSK	3/4	6,3	7,2	12,4	7,46	8,29	8,78	9,05
QPSK	5/6	7,3	8,5	15,6	8,29	9,22	9,76	10,05
QPSK	7/8	7,9	9,2	17,5	8,71	9,68	10,25	10,56
16-QAM	1/2	9,3	9,8	11,8	9,95	11,06	11,71	12,06
16-QAM	2/3	11,4	12,1	15,3	13,27	14,75	15,61	16,09
16-QAM	3/4	12,6	13,4	18,1	14,93	16,59	17,56	18,10
16-QAM	5/6	13,8	14,8	21,3	16,59	18,43	19,52	20,11
16-QAM	7/8	14,4	15,7	23,6	17,42	19,35	20,49	21,11
64-QAM	1/2	13,8	14,3	16,4	14,93	16,59	17,56	18,10
64-QAM	2/3	16,7	17,3	20,3	19,91	22,12	23,42	24,13
64-QAM	3/4	18,2	18,9	23,0	22,39	24,88	26,35	27,14
64-QAM	5/6	19,4	20,4	26,2	24,88	27,65	29,27	30,16
64-QAM	7/8	20,2	21,3	28,6	26,13	29,03	30,74	31,67

NOTE 1: Figures in italics are approximate values.
NOTE 2: Quasi Error Free (QEF) means less than one uncorrected error event per hour, corresponding to BER = 10^{-11} at the input of the MPEG-2 demultiplexer.
NOTE 3: Net bit rates are given after the Reed-Solomon decoder.

1.3.3 set gain command

Format	ATSG$(tx1_gain),$(tx1_gain)_
	For example: ATSG85.0,85.0_
paramet er	tx1_gain: Transmitter 1 gain
	tx2_gain: Transmitter 2 gain
use	Used to dynamically adjust the output power. For example, when the SNR/RSSI of the receiving end signal is high, the output power can be reduced through the remote control link. When the SNR/RSSI of the receiving end signal is low, the output power can be increased (transmitter).
return value	For example:
	ATSG85.0,85.0_
	set gain 85.000000 85.000000 OK
Remark	The setting command will not be saved when the power is turned off.

1.3.4 set modulation mode command

Format	ATSM$(gi), $(code_rate), $(constellation)_
	For example: ATSM1,1,2_
paramet er	Guard interval GI: 0 1/32; 1 1/16; 2 1/8; 3 1/4;
	Convolution code rate code rate: 0 1/2; 1 2/3; 2 3/4; 3 5/6; 4 7/8;
	Constellation constellation: 0 QPSK; 1 QAM16; 2 QAM64;
use	Dynamically adjust the air interface rate. You can adjust the air interface rate to a higher rate when at a short distance, and lower the air interface rate at a long distance (sending end).
return value	For example:
	ATSM1,1,2_
	GI:1/16,CR:2/3,MOD:QAM64,OK
Remark	The setting command will not be saved when the power is turned off.

1.3.5 get device status command

Format	ATGD_
paramet er	none
use	Used to query the current number of transmitting antennas, guard interval, convolutional code rate, number of constellations, transmitting frequency, bandwidth, and gain parameters (transmitter)
return value	For example:
	ATGD_
	SISO,GI:1/16,CR:1/2,MOD:QPSK,freq:800000KHz,bw:8000KHz,tx1_gain:86.000000
	tx2_gain:86.000000 OK
Remark	Query command

1.3.6　set encoder command

Format	ATSE$(mode),$(rt),$(bitrate),$(gop),$(audio) _
	For example: ATSE0,0,0.0,0,0_
parameter	Mode options mode: 0 h264; 1 h265
	Low latency option rt: 0 normal latency; 1 low latency; (requires the receiving end to also turn on this option at the same time for paired use)
	bitrate: 0 let system decide; >0 specify bitrate(float)
	I frame interval gop: 0 let system decide; >0 specify gop
	Audio encoding options audio: 0 disable; 1 enable
use	Used to set encoding parameters (sender)
return value	For example: ATSE0,0,0.0,0,0_ MODE:0,RT:0,bitrate: 0.0Mbps,gop:0,audio:0,OK
Remark	1. Set the command and save it after power off. 2. Only some models support low-latency option settings (please consult the supplier for details)

1.3.7　get encoder command

Format	ATGE_
parameter	none
use	Used to query encoding parameters (sender)
return value	For example: ATGE_ MODE:0,RT:0,bitrate:4.0Mbps,gop:10,audio:0,aes:0,OK
Remark	1、 Query command 2、 The aes parameter indicates the current encryption status: 0 disable; 1 enable

1.3.8 get input command

Format	ATGI_
parameter	none
use	Used to query the current camera input parameters (sender)
return value	For example: ATGI_ input_size:1080p,input_rate: 60fps,sensor_type:hdmi,OK
Remark	Query command

1.3.9 set input command

Format	ATSI$(input_size) ,$(input_rate) _ For example: ATSI1080,25_
parameter	Input resolution input_size: 0 let system detect; >0 specify input size
	Input frame rate input_rate: 0 let system detect; >0 specify input fps
use	Used to specify input resolution and frame rate to meet some special signal sources or some special application needs (sending end)
return value	For example: ATSI1080,25_ input_size:1080p,input_rate: 25fps,OK
Remark	1、 After the user specifies the input resolution and frame rate through this command, the system will no longer detect the signal source (**Use with caution**） 2、 Users can restore the default through the following command: ATSI0,0_ 3. Set the command and save it after power off.

1.3.10 set output command

Format	ATSO$(output_size) ,$(output_rate) _ For example: ATSO720,30_
parameter	Sender: encoding output resolution output_size: 0 equal to input_size; >0 specify output size Receiving end: HDMI output resolution (720, 1080)
	Sender: encoding output frame rate output_rate: 0 equal to input_rate; >0 specify output_rate(fps) Receiving end: HDMI output frame rate 720p supports frame rate (50, 60); 1080p supports frame rate (24, 25, 30, 50, 60)
use	Sending end: used to specify the encoding output resolution and frame rate to meet the scaling and frame reduction requirements of certain applications. Receiver: used to configure the resolution and frame rate of HDMI output
return value	For example: ATSO720,30_ output_size:720p,output_rate: 30fps,OK
Remark	1. For HDMI input, this command is invalid when AV input 2、 output_size <= input_size；output_rate<=input_rate 3. Set the command and save it after power off.

1.3.11 set user command

Format	ATSU$(vin),$(ain)_ For example: ATSU0,1_
parameter	Video input selection vin: 0 let the system detect;1 force cvbs input;2 force hdmi/sdi input Audio input selection ain: 0 let system detect; 1 force analog input
use	Used to meet specific application requirements (for example: HDMI/SDI input video, MIC input audio)
return value	For example: ATSU0,1_ ATSU0,1 OK
Remark	1、 Set the command and save it after power off.

1.3.12 get user command

Format	ATGU _ For example: ATGU_
parameter	none
use	Used to query user-specific configuration
return value	For example: ATGU_ ATGU0,1 OK
Remark	1、 Query command 2、 Please refer to ATSU command for return parameter description.

1.3.13 set audio input command

Format	**ATSAI$(lin),$(ain_vol) _** For example: ATSAI0,50_
paramet er	Analog audio input mode selection lin: 0 mic in; 1 line in Analog audio input volume control ain_vol: mic_in recommended 50; line in recommended 0
use	Used to set analog audio input parameters
return value	For example: RELEASED0.50_ FREE 0.50 OK
Remark	1、 Set the command and save it after power off. 2、 ain_vol setting range [-78, 80] 3、 Not all models support this command

1.3.14 get audio input command

Format	**ATGAI _** For example: ATGAI_
paramet er	**none**
use	Used to query analog audio input configuration
return value	For example: ATGAI_ ATGAI0.50 OK
Remark	1、 Query command 2、 Please refer to ATSA command for return parameter description. 3、 Not all models support this command

1.3.15 set receiver command

Format	ATSR$(freq), $(bw), $(rt), $(cvbs)_
	For example: ATSR320000,6000,0,0_
paramet er	DR2C carrier center frequency freq (KHz) 161000~860000 (161MHz~860MHz, 1KHz step)
	DR2C channel bandwidth bw (KHz) 2000~8000(2MHz~8MHz, 1KHz step)
	Low latency option rt: 0 normal latency; 1 low latency; (requires the transmitter to also turn on this option at the same time for paired use)
	AV output format cvbs: 0 pal; 1 ntsc
use	Used to set receiver parameters
return value	For example:
	ATSR320000,6000,0,0_
	ATSR320000,6000,0,0 OK
Remark	1、 Set the command and save it after power off.
	2. Only some models support low-latency option settings (please consult the supplier for details)

1.3.16 get receiver command

Format	ATGR_
paramet er	none
use	Used to query the receiving end parameters
return value	For example:
	ATGR_
	ATGR320000,6000,0,aes:0,cvbs:0 OK
Remark	1、 Query command
	2、 The aes parameter indicates the current encryption status: 0 disable; 1 enable
	3、 The cvbs parameter indicates the current AV output format: 0 pal; 1 ntsc

1.3.17 get bit error rate 命令

Format	ATGB_
paramet er	none
use	Used to query the bit error rate and signal strength of the dual antennas at the receiving end
return value	For example:
	ATGB_
	ATGB ber1:0.00% ber2:0.00% RSSI1:54 RSSI2:53 Lock1:1 Lock2:1 OK
Remark	1、 Query command
	2、 ber1 and ber2 respectively represent the bit error rate of each antenna, ranging from 0.0% to 100.0%
	3、 RSSI1 and RSSI2 respectively represent the signal strength of each antenna, ranging from 0 to 100.
	4、 Lock1 and Lock2 respectively represent the signal locking status of each antenna (1 represents signal locking)

1.3.18 set ip address command

Format	ATSIP$(ip), $(ip) _
	For example: ATSIP192.168.1.215,192.168.1.215_
parameter	Local IP address
	Local IP address (repeat to confirm)
use	Used to set the receiving IP address
return value	For example: ATSIP192.168.1.215,192.168.1.215_ ATSIP192.168.1.215 OK
Remark	1. After setting the IP address, the receiving end needs to be restarted to take effect. 2. Set the command and save it after power off.

1.3.19 Get IP address command

Format	ATGIP_
	For example: ATGIP_
parameter	none
use	Used to query the current IP address of the receiving end
return value	For example: ATGIP_ ATGIP192.168.0.215 OK
Remark	Query command

1.3.20 set password command

Format	ATSP$(password), $(password) _
	For example: ATSP123456,123456_
parameter	AES key password: 6-digit password (ASCII)
	AES key password: 6-digit password (ASCII) (repeat to confirm)
use	Used to set the AES key of the transceiver and receiver
return value	For example:
	ATSP123456,123456_
	ATSP123456 OK
Remark	1. When the password is all 0s, turn off AES encryption.
	2. Set the command and save it after power off.

1.3.21 set data transfer command

Format	ATST$(baud rate), $(parity) _
	For example: ATST115200,0_
parameter	baud rate: 1200、2400、4800、9600、19200、38400、57600、115200
	Check parity: 0: None; 1:Odd; 2:Even
use	Used to set the baud rate and check bit of the data transparent transmission serial port
return value	For example:
	ATST115200,0_
	ATST115200,0 OK
Remark	Set command

1.3.22 get data transfer command

Format	Traffic safety_
parameter	none
use	Used to query the baud rate and check digit of the data transparent transmission serial port
return value	For example:
	Traffic safety_
	ATGT115200,0 OK
Remark	Query command

1.3.23 OSD overlay protocol

Format	**ATOSD$(idx), $(x),$(and),$(str) _** For example: ATOSD0,40,20,height: 100m_
paramet er	idx index: 0~7 (supports OSD overlay of 8 areas) x coordinate: 0~1919 y coordinate:0~1079 str: string to be displayed at the corresponding coordinates (The space symbol is used to clear the display)
use	Used to overlay user OSD information on the video screen
return value	none
Remark	1. The user specifies the x and y coordinates of the OSD display according to the maximum 1920x1080 pixels, and the system will correct the coordinates according to the actual display situation. 2、**The str parameter cannot contain the '_' character**

1.4 Customer project customization commands

The following commands are AT commands added for customer-customized projects, commands that must be supported by non-conventional shipping firmware.

1.4.1 set frequency command

Format	ATSF$(freq)_
	For example: ATSF750000_
parameter	Transmitter carrier center frequency freq (KHz) 200000~2700000 (200MHz~2.7GHz, 1KHz step)
use	Dynamically modify the center frequency, effective immediately (sender)
return value	For example:
	ATSF750000_
	set freq 750000 OK
Remark	1、 Setting command will not be saved after power off

1.4.2 set audio encoder command

Format	FALSE$(audio_bitrate) _
	For example: ATSAE64.0_
parameter	Audio bitrate audio_bitrate: unit Kbps (float)
use	Used to set the audio encoding bit rate
return value	For example:
	ATSAE64.0_
	ATSAE64.0Kbps OK
Remark	1、 Set the command and save it after power off.

1.4.3 get audio encoder command

Format	ATGAE_
	For example:ATGAE_
parameter	none
use	Used to query the audio encoding bit rate
return value	For example:
	ATGAE_
	ATGAE64.0Kbps OK
Remark	1、 Query command

1.4.4 set channel command

Format	ATSC$(chn), $(disp_num) _ For example: ATSC0,1_
parameter	Display channel number 0~3(When displaying in four-split screen, it is used to specify the starting display channel.)
	Display mode 1: single-channel full-screen display; 4: four-split screen display
use	Used to set the receiving end display mode and display channel (Quad-screen display or corresponding channel full-screen display)
return value	For example: ATSC0,1_ ATSC0,1 OK
Remark	Set command

1.4.5 get channel command

Format	ATGC_
parameter	none
use	Used to query the receiving end display mode and display channel
return value	For example: ATGC_ ATGC0,1 OK
Remark	Query command

1.4.6 get status command

Format	ATGS_
parameter	none
use	Used to query the status of the receiver
return value	For example: ATGS_ ATGS RF:800.0MHz BW:4.0MHz MOD:QPSK CR:2/3 GI:1/16 AIR:3.90Mbps AES:OFF SIG1:20 SIG2:0 BER1:0.00% BER2:22.03% Lock1:1 Lock2:1 REC OFF No Storage OK
Remark	1、 Query command 2、 AIR represents the air interface rate calculated based on the current wireless parameters (The actual transmission data bit rate shall not be higher than it) 3、 SIG1 and SIG2 respectively represent the signal strength of each antenna, ranging from 0 to 100. 4、 BER1 and BER2 respectively represent the bit error rate of each antenna, ranging from 0.0% to 100.0%. 5、 Lock1 and Lock2 respectively represent the signal locking status of each antenna (1 represents signal locking)

1.4.7 dson command

Format	**ATDSON$(on) _**
	For example: ATDSON1_
parameter	Receiver OSD display switch
use	Instead of using OSD buttons, use AT commands to control the receiving end OSD display.
return value	For example:
	ATDSON1_
	ATDSON1 OK
Remark	1、 Set the command and save it after power off.

1.4.8 set rec command

Format	**ATSREC$(rec) _**
	For example: ATSREC1_
parameter	Receiver recording initiation action 0: Close recording; 1: Start recording
use	Replaces the REC button to initiate recording action
return value	For example:
	ATSREC1_
	ATSREC1 OK
Remark	1、 The setting command will not be saved when the power is turned off.

1.4.9 get rec command

Format	**ATGREC _**
	For example: ATGREC_
parameter	**none**
use	Used to query the last recording initiation action and the current recording status. For example, when the storage device is not connected, the current recording status may be inconsistent with the recording initiation action.
return value	For example:
	ATGREC_
	ATGREC1,1 OK
Remark	1、 Query command
	2、 For the description of return parameters, please refer to the introduction of the purpose.

1.4.10 set ts command

Format	ATSTS$(ts) _
	For example: ATSTS1_
parameter	Transport stream protocol ts: 0 our private protocol; 1 mpegts protocol
use	Set transport stream protocol (**Compatible with other people's product needs**)
return value	For example:
	ATSTS1_
	ATSTS1 OK
Remark	1、 Set the command and save it after power off.

1.4.11 get ts command

Format	ATGTS_
	For example: ATGTS_
parameter	**none**
use	Used to query the currently used transport stream protocol
return value	For example:
	ATGTS_
	ATGTS1 OK
Remark	1、 Query command
	2、 Please refer to the ATSTS command for return parameter description.

1.4.12 set key command

Format	ATSK$(ckey)_
	For example: ATSK12345678abcdefghIJKLMNOP!@#$%^&*_
parameter	Aes key ckey:**32 ascii characters**，**All '0' means disabling aes encryption and decryption**
use	Used to set the key for aes encryption and decryption
return value	For example:
	ATSK12345678abcdefghIJKLMNOP!@#$%^&*_
	ATSK12345678abcdefghIJKLMNOP!@#$%^&* OK
Remark	1. After setting the key,**Requires a reboot to take effect**
	2. Set the command and save it after power off.

1.4.13 get sn command

Format	ATGSN_
	For example: ATGSN_
parameter	**none**
use	Used to obtain unique serial number
return value	For example:
	ATGSN_
	SN:e461c4518f221e2c OK
Remark	Query command

1.4.14 set reset command

Format	ATSRST$(reset) _
	For example: ATSRST1_
parameter	Receiver software reset command 0: No action; 1: Software reset
use	Software restart system
return value	For example:
	ATSRST1_
	ATSRST1 OK
Remark	1、 The setting command will not be saved when the power is turned off.