R51 GNSS RECEIVER
USER MANUAL

SHANGHAI ALLYNAV TECHNOLOGY CO., LTD
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revision history

revision number	Revision Notes	Revised by	date
V 1.0	Publish first draft	Zhang Bing	April 2021 _
V 1.1	Supplementary solar controller and gyroscope description section	Zhang Bing	April 2021 _

forward Word

Introduction

Welcome to the R51 Universal Receiver Product Instruction Manual. This manual mainly takes the R51 receiver as an example to describe how to install, set up and use this series of products.

Disclaimer

LianShi Navigation Co., Ltd. is committed to continuous improvement of product functions and performance. Later product specifications and manual contents may be changed accordingly without prior notice, please understand! If the icons, pictures, etc. in the manual are different from the actual product, please refer to the actual product. The company reserves the right of final interpretation of all technical parameters and graphic information. Before using this product, please read this instruction manual carefully. For the loss caused by misoperation of this product without following the requirements of the instruction manual or failing to correctly understand the requirements of the instruction manual, LianShi will not be responsible for any loss.
This product is designed to withstand certain harsh environments. However, this device is a high precision electronic instrument and should be treated with care. Operating or storing the receiver outside the specified temperature range may damage it.

technical and service

If you have any questions and the product documentation does not provide the relevant information, please contact your local technical office. Or log on to the LLYNAV website (http://www. a llynav.cn) to inquire and download the latest version of the product and related technical information, or call the national service hotline: 400-1698-003/021-61200180 to contact us, we Will be happy to serve you.

Security Information

Before using the R51 receiver product, please ensure that you have carefully read and understood this user guide and safety requirements.

1Product introduction

1.1 Introduction

The R30 BeiDou/GNSS receiver is a multi-functional high-precision RTK BeiDou/GNSS receiver independently developed by LianShi Navigation Co., Ltd.. Built-in high-precision OEM board, full Netcom 4G module, Ethernet communication interface, high-speed data storage module, CAN data communication, etc., each functional module can be customized according to customer needs. This receiver has industrial grade design, strong anti-interference ability and high stability, and is widely used in precision agriculture, driving test and driving training, surveying and mapping engineering, mechanical control, high-precision vehicle positioning and navigation, geographic information, deformation monitoring and other industries.

1.2 Product Features

(1) Using high-precision positioning and orientation GNSS technology, it supports 432 channels.

GPS:L1/L2
GLONASS L1/L2
Galileo E1/E5b
BDS:B1 / B2

(2) Built-in boards are optional and corecom UM482 boards or dream core MXT906B boards

(3) The output rate of the 9-axis gyroscope is adjustable from 0.1 to 200 Hz, and the attitude measurement accuracy is static 0.05 degrees and dynamic 0.1 degrees

(4) Support bluetooth wireless access, convenient for user configuration

(5) Support 4G full Netcom

(6) Up to 20HZ data update rate

(7) IP67 waterproof rating

(8) Compact internal shock absorption technology, strong adaptability to vibration and shock, and high reliability

(9) Built-in solar controller, can connect 4~ 5A 21.6~ 26 V solar panel

(10) The solar panel battery can use lead-acid battery, gel battery

(11) Optional built-in 9.75Ah lithium battery

1.3 **Product parameter table**

Displacement measurement	
Static relative positioning accuracy	Horizontal ±(2.5mm+0.5ppm)RMS
	Vertical ±(5mm+0.5ppm)RMS
Dynamic relative positioning accuracy	Horizontal ±(8mm+1ppm)RMS
	Vertical ±(15mm+1ppm)RMS
sampling interval	0s~24h
Upload interval	0s~24h
output signal	NB/4G Cat1, PORT (nine-pin aviation plug)
Operating mode	MODE0 debug mode
	MODE1 Displacement measurement mode
Data Format	Support RTCM32 and real-time dynamic upload of raw observation data
Physical Dimensions and Electrical Characteristics	
Input voltage	9～26V DC (standard adapt to 12V DC)
Power consumption	≤ 4W (typ.)
physical size	196.5×196.5×129.5mm
weight	1.3kg (without battery)
Lithium Ion Battery	9.75Ah _ _ (70.2Wh) optional
Solar Controller	maximum input voltage of 26V is allowed, and a solar panel with 4~ 5A 21.6V no-load voltage or close to this value is recommended
Environmental indicators	
Installation method	Standard observation pier, cast-in-place concrete pier, steel structure, etc.
Operating temperature	-40~+60 ℃

1.4 User **Interface**

1.4.1 **Front**

1.4.1 Bottom panel

The bottom panel has a nine-pin aviation plug, 6 LED indicators , and a SIM card slot. In order to achieve IP67 waterproof level, the SIM card baffle is fixed with 2 screws

 Power light: red and blue flash alternately when power on

 Differential light red: (monitoring mode is disabled)

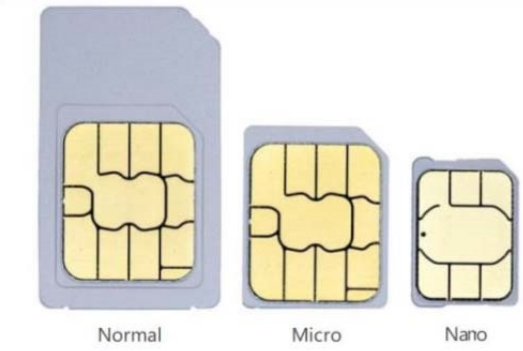
 4G light red: 4G is not online, flashes every 5s , and flashes every 1s after going online.

 Differential data status light red (monitoring mode is disabled)

 Storage light red : (Monitoring mode is disabled)

 bluetooth light is red : the bluetooth is not connected and flashes once for 3 s, and the bluetooth flashes twice for 1 s after the bluetooth is connected.

SIM card : Use a NANO SIM card, with the chip facing down



PORT nine -pin aviation plug: used for 12V DC power input and one R S232 communication serial port.

1. 5 Accessories

This chapter provides accessory information. Before starting the installation, make sure that all accessories used in the project meet specifications and standards.

1.5.1 Configuration List

name	quantity	picture
R 51 Universal Receiver (Host)	1 pcs	
Nine core aviation plug power cord	1 pcs	
Nine core aerial plug setting line	1pcs	

1.5.2 Data line interface definition

nine -core aerial plug setting line mainly includes 1 DC power port, 2 R S232 serial ports The nine-core aviation plug power cord includes a solar power supply interface and a battery power supply interface

Defined as follows

R51 universal receiver P ORT nine-core aviation plug pin definition

Aviation PIN sequence (male)	definition
1	POWER+
2	POWER -
3	SOLAR +
4	L E_AC BAT
5	R S232 RX
6	RS232TX _
7	G ND
8	G ND
9	P_ON _

Nine-core aerial plug power cord P IN pin definition

Aviation PIN sequence (female)	definition
1	(empty)
2	(empty)
3	SOLAR + (Solar Anode)
4	B AT+ (battery positive)
5	(empty)
6	(empty)
7	SOLAR- (Solar Negative)
8	B AT- (battery negative electrode)
9	(empty)

Nine-core aerial plug setting line P IN pin definition

Aviation PIN sequence (female)	definition
1	DC 12V positive
2	D C 12V negative pole
3	COM RS232B
4	(empty)
5	C ONFIG RS232 B
6	C ONFIG RS232A
7	COM RS232A
8	(empty)
9	(empty)

PORT RS232: Various parameters of the receiver can be configured through the serial

port tool, the default baud rate is 115200 .

2 Overview of the configuration instruction set

System debugging instructions	
S ET UART CONFIG	Open system configuration
M ODE0	Switch to debug mode
M ODE1	Switch to monitoring work mode
C ONCOM12	Connect to G NSS board debug interface
C ONCOM13	Connect the gyroscope debugging interface
C ONCOM14	Connect 4G network module debugging interface
C ONCOM15	System debugging interface and Bluetooth transparent transmission
C ONCOM25	Transparent transmission between G NSS board and Bluetooth module
B ATTIME60	Set the time interval for uploading power information, once every 60 seconds; the setting range is 0 ~ 255 seconds
S AVE LIST	save system configuration
G NSS board debugging instructions	
U NLOGALL	Turn off all outputs of the G NSS board
L OG RANGEB ONTIME 1	Hz raw observation data in binary format
L OG RANGEA ONTIME 1	Output 1 Hz raw observation data in ASCII format
LOG GPSEPHEMB ONTIME 300	GPS ephemeris in binary format , every 300 seconds
LOG BD2EPHEMB ONTIME 300	DS ephemeris in binary format , every 300 seconds
LOG GLOEPHEMERISB ONTIME 300	GLO ephemeris in binary format , every 300 seconds
LOG GPSEPHEMA ONTIME 300	Output GPS ephemeris in ASCII format , every 300 seconds
M ODE ROVER	Converting from Base Mode to Rover Mode
L OG GPGGA ONTIME 0.5	Output G PGGA statement 2 Hz
MASK 15	Set the satellite altitude cutoff angle to 15 degrees
SAVECONFIG	Save the board configuration
Gyro debugging instructions	
41 6C 6C 79 02 FF AA 03 03 00	Modify the output frequency of the gyroscope with ID number 0 2 to 1 Hz (H EX send)
41 6C 6C 79 02 FF AA 0 4 0 6 00	Modify the baud rate of the gyroscope serial port with ID number 0 2 to 115200 (sent by H EX)
41 6C 6C 79 02 FF AA 2D FF 00	Modify the ID number of the gyroscope whose ID number is 0 2 to FF ; allow the modification range of 0 0 ~ FF (H EX send)
4G network debugging instructions	
SETG3CONFIG _	Turn on 4G configuration state
SETG3MODE0 _	4 G module switches to debug mode
SETG3IP0192.168.1.100 _	Set the TCP server IP to 1 92.168.1.100

SETG3PORT01002 _	Set the TCP server port to 1002
SETG3MODE2 _	Set 4G as TCP transparent transmission working mode
SETG3QUIT _	Save and exit the 4G configuration state, and the 4G configuration parameter information will pop up

Detailed explanation of gyroscope configuration instructions:
First adjust the display interface to H EX display, the ID of the gyroscope can be queried in the data 4 1 6C 6C 79 __ field spit out from the serial port .
Commands are sent in hex

ID number of the gyroscope module whose ID is 02 to FF. The command is as follows :
Input example: 41 6C 6C 79 02 FF AA 2D FF 00
The red font is the gyroscope ID; the blue font is the modification ID option; the green font is the ID to be written

Modify the frequency of the serial port output data of the device whose gyroscope ID is 02 to 50 Hz. The command is as follows :
Input example: 41 6C 6C 79 02 FF AA 03 08 00
The red font is the gyroscope ID; the blue font is the modification frequency option; the green font represents the specific output frequency (08=50HZ)
For example , the command to modify the serial port baud rate of the device whose gyroscope ID is 02 is 115200 is as follows:
Input example: 41 6C 6C 79 02 FF AA 0 4 0 6 00
The red font is the gyroscope ID; the blue font is the option to modify the baud rate; the green font represents the baud rate to be set (0 6 = 115200)

Notice:

1、 Before preparing to modify the parameters of the G NSS board , gyroscope, and 4G network module, it is necessary to send the system debugging command, connect to the corresponding debugging interface, and then send the configuration command of the corresponding module.

2、 If you want to set the parameters of each module of the system through Bluetooth, you need to send an instruction to connect to the corresponding debugging interface first; for example, CONCOM25/CONCOM35/CONCOM45 can be configured with GNSS board/gyroscope/ 4G network module respectively.

3、 After the module parameter configuration is completed, the system debugging command needs to be sent again, and the device can be switched to the MODE1 working mode before it can work normally.

4、 System debugging and each module have corresponding save configuration commands. After debugging, you need to send save commands, otherwise the corresponding configuration will be invalid after power off.

3 data protocol

3.1 Gyroscope Data Protocol

3.1.1 Time output:

0x55 _	0x50 _	Y Y	M M	D D	H H	M M	D D	M SL	M SH	SUM _

YY : year, year 20YY

MM : month

DD : day

HH : Hour

MM : points

SS : seconds

MS : milliseconds

Millisecond calculation formula:

MS=((MSH<<8)|MSL)

Sum=0x55+0x50+YY+MM+DD+HH+MM+SS+MSL+MSH

3.1.2 Acceleration output:

0x55 _	0x51 _	Ax L	AxH	A y L	A y H	A zL	A zH	TL	TH	SUM _

Calculation method:

ax=((AxH <<8)| AxL)/32768*16g (g is the acceleration of gravity, preferably 9.8m/s2)

ay=((AyH <<8)| AyL)/32768*16g (g is the acceleration of gravity, preferably 9.8m/s2)

a z =((AzH <<8)| AzL)/32768*16g (g is the acceleration of gravity, preferably 9.8m/s2)

Temperature calculation formula:

T=((TH<<8)|TL) /100 ℃

Checksum:

Sum=0x55+0x51+AxH+AxL+AyH+AyL+AzH+AzL+TH+TL

illustrate:

1. The data is sent in hexadecimal , not ASCII .

2. Each data is divided into low byte and high byte and transmitted in turn, and the two are combined into a signed short type of data.

For example , the X- axis acceleration data Ax , where AxL is the low byte, AxH is the high byte. The conversion method is as follows:

Assuming Data is actual data, DataH its high byte part, DataL for its low byte part, So:

Data=(short) (DataH <<8| DataL). Here we must pay attention to DataH Need to cast to a signed first

of the short type of the number is shifted later, and the data type of the Data is also a signed short type.

This is how negative numbers can be represented.

3.1.3 Angular velocity output:

0x55	0x52	wxL	wxH	wyL	wyH	wzL	wzH	TL	TH	SUM

Calculation method:

wx =((wxH <<8)| wxL)/32768*2000(° /s)

wy =((wyH <<8)| wyL)/32768*2000(° /s)

wz =((wzH <<8)| wzL)/32768*2000(° /s)

Temperature calculation formula:

T=((TH<<8)|TL) /100 ℃

Checksum:

Sum=0x55+0x52+wxH+wxL+wyH+wyL+wzH+wzL+TH+TL

3.1.4 Angle output:

0x55	0x53	RollL	RollH	PitchL	PitchH	YawL	YawH	TL	TH	SUM

Calculation method:

Roll angle (x axis) Roll=((RollH <<8)| RollL)/32768*180(°)

Pitch angle (y - axis) Pitch=((PitchH <<8)| PitchL)/32768*180(°)

Yaw angle (z axis) Yaw=((YawH <<8)| YawL)/32768*180(°)

Temperature calculation formula:

T=((TH<<8)|TL) /100 ℃

Checksum:

Sum=0x55+0x53+RollH+RollL+PitchH+PitchL+YawH+YawL+TH+TL

Note:

1. The coordinate system used for attitude angle settlement is the northeast sky coordinate system, and the module is placed in the positive direction , as shown in the figure below.

is the X axis, forward is the Y axis, and upward is the Z axis. The rotation order of the coordinate system when Euler angles represent the attitude is defined as

zyx, that is, rotate around the z -axis first, then around the y -axis, and then around the x -axis.

2. Although the range of the roll angle is ± 180 degrees, in fact, because the coordinate rotation order is ZYX , the attitude is expressed.

When , the range of the pitch angle (Y- axis) is only ± 90 degrees, and when it exceeds 90 degrees, it will change to less than 90 degrees, and at the same time

Make the angle of the X axis greater than 180 degrees. For detailed principles, please refer to Baidu's Euler angle and attitude representation.

3. Since the three axes are coupled, they will show independent changes only when the angle is small, and the attitude will be changed when the angle is large.

The angle will be coupled to change, for example, when the Y- axis is close to 90 degrees, even if the attitude only rotates around the Y - axis, the angle of the X- axis

It will also change greatly, which is an inherent problem of the Euler angle representing the attitude.

3.1.5 Magnetic field output:

0x55	0x54	HxL	HxH	HyL	HyH	HzL	HzH	TL	TH	SUM

Calculation method:

Magnetic field (x - axis) Hx =((HxH <<8)| HxL)

Magnetic field (y - axis) Hy =((HyH <<8)| HyL)

Magnetic field (z - axis) Hz = ((HzH <<8)| HzL)

Temperature calculation formula:

T=((TH<<8)|TL) /100 ℃

Checksum:

Sum=0x55+0x54+HxH+HxL+HyH+HyL+HzH+HzL+TH+TL

3.2 Voltage Data Protocol Data Protocol

Voltage data is output in the form of Chinese characters plus decimal values
like:
Solar 12.0, lead-acid battery 8.7, lithium battery 8.4, USB1.5, temperature 36.6

Note:
The charging process of the solar controller is as follows
Solar power allows a maximum input voltage of 26V, and a solar panel with a no-load voltage of 21.6V or close to this value is recommended.
When the solar voltage is greater than 17.2V, the battery starts to be charged. When the battery voltage exceeds 10.6V, the controllable switch is turned on, the equipment starts to work, and the internal lithium battery is charged at the same time.

voltage of the built-in lithium battery is greater than 6.2V , the device starts to work.
When there is no built-in lithium battery, and the battery voltage exceeds 10.6V , the device can be turned on to work.

4 Directive configuration example

Example: Send commands through the RS232 serial port to set the G NSS board to output 10 Hz GPGGA text, modify the gyroscope output frequency to 10 Hz; modify the 4G network TCP server address and port number; modify the voltage upload time to 60 seconds1 times; the order of sending commands is as follows.
SET UART COFIG
MODE 0
CONCOM12
LOG GPGGA ONTIME 0.1
SAVECONFIG

CONCOM13
//For example, the gyroscope ID is 02 (the following commands are sent in the form of HEX)
41 6C 6C 79 02 FF AA 03 06 00

CONCOM14
SETG3CONFIG

SETG3IP0 192.168.1.100
SETG3PORT0 8001
SETG3MODE2
SETG3QUIT

B ATTIME60
MODE1
SAVE LIST

The command to configure the above parameters using Bluetooth is as follows (first need to connect to Bluetooth, and send the following commands from the Bluetooth serial port) .

SET UART COFIG
MODE 0
CONCOM25
LOG GPGGA ONTIME 0.1
SAVECONFIG

CONCOM35
//For example, the gyroscope ID is 02 (the following commands are sent in the form of HEX)
41 6C 6C 79 02 FF AA 03 06 00

CONCOM45
SETG3CONFIG
SETG3IP0 192.168.1.100
SETG3PORT0 8001
SETG3MODE2
SETG3QUIT

B ATTIME60
MODE1
SAVE LIST

5 Equipment FAQ

fault phenomenon	Failure Analysis Cause	Solution
Can't find bluetooth ID	phone is too far from the receiver or the ID is not fully loaded	mobile phone is close to the receiver to search again for the Bluetooth device whose ID number is the device S N number
4G does not upload data	The 4G module IP or port configuration is wrong, and the 4G SIM card is installed in the wrong direction device is in MODE0 debug mode	Reconfigure the 4G module IP or port, check whether the SIM card is installed correctly, and adjust the device to MODE1 working mode.
Device light is off	The power cord is loose or reversed	Check whether the power cord is reversed and tightened
The output data is garbled or all dots	Incorrect baud rate setting	Check that the baud rate set by the computer serial port receiving program is consistent with the baud rate of the device CONFIG .

6 FCC Statement

FCC Statement

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) This device must accept any interference received, including interference that may cause undesired operation.

FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment .This equipment should be installed and operated with minimum distance 20cm between the radiator& your body.

Note : This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable

protection against harmful interference in a residential installation. This equipment generates,uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

—Reorient or relocate the receiving antenna.

—Increase the separation between the equipment and receiver.

—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

—Consult the dealer or an experienced radio/TV technician for help.