

GNSS DGPS-RTCM Test Guide

GNSS Module Series

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About the Document

History

Revision	Date	Author	Description
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1 Introduction

This document mainly introduces how to use the RTCM function of Quectel GNSS module based on MTK's platform. RTCM versions of V2.0, V2.1, V2.2, V2.3 are supported now.

This document is applicable to Quectel L76-L module currently.



2 RTCM Test With Ntrip

2.1. Brief Introduction of Ntrip

Ntrip (Networked Transport of RTCM via Internet Protocol) is designed to disseminate differential correction data or other kinds of GNSS streaming data to stationary or mobile users over the Internet, allowing simultaneous PC, Laptop, PDA, or receiver connections to a broadcasting host.

Ntrip system consists of four elements which are described as below:

- NtripSources: generate data streams (correction data) at a specific location.
- NtripServers: transfer data streams from a source to the NtripCaster.
- NtripCaster: the major system component, works as a server. It receives data streams from NtripServers which are from all over the world, responds to request from NtripClients and sends data streams to NtripClients.
- NtripClients: finally access data streams of desired NtripSources on the NtripCaster.

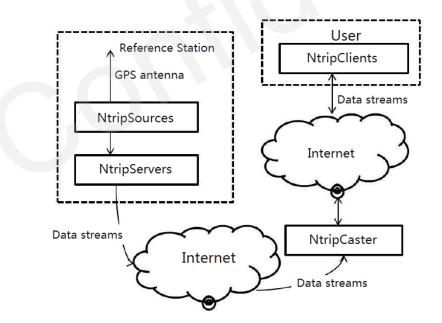


Figure 1: Ntrip System



2.2. RTCM Client Setup

Users should only use RTCM client to receive data streams (differential correction data) from Internet.

The RTCM client used by Quectel is "Bnc210-Windows-static.exe", which can be downloaded from <u>http://igs.bkg.bund.de/ntrip/download</u>.

2.3. Ntrip Client Demo

The Ntrip client demo is shown as following figure.

File Help ervations RINEX Ephemeris RINEX Editing & QC SP3 Comparison Broadcast Corrections Feed Engine Serial Output Outages Image: Comparison Port settings to feed a serial connected receiver. Mountpoint PADO0 Port name COM2 Baud rate 9600 Flow control OFF Image: Comparison Broadcast 1 Image: Comparison Broadcast 2 Data bits 8 Parity NONE Stop bits 1 Image: Comparison Height Sampling 0 sec Image: Comparison Streams: resource loader / mountpoint decoder lat long nmes: ntrip byte(s) Log Throughput Latency PPP Plot Image: Comparison Dista 2 0 byte(s)	🗶 BKG Ntrip Client (BNC) Version 2.12.2
Port settings to feed a serial connected receiver. Mountpoint PADO0 Port name COM2 Baud rate 9600 • Flow control OFF • Data bits Baud rate 9600 • Flow control OFF • Data bits NMEA Auto • File (ful path) Height Sampling 0 sec • Streams: resource loader / mountpoint decoder lat Intrip.gnsslab.cn:2101/PADO0 RTCM_2.3 Log Throughput Latency PPP Plot	File Help
Mountpoint PADO0 Port name COM2 Baud rate 9600 Data bits 8 Parity NONE NMEA Auto Streams: resource loader / mountpoint decoder lat Intrip.gnsslab.cn:2101/PADO0 RTCM_2.3 Auto PP Plot	ervations RINEX Ephemeris RINEX Editing & QC SP3 Comparison Broadcast Corrections Feed Engine Serial Output Outages
Port name COM2 Baud rate 9600 Flow control OFF Stop bits 1 Data bits 8 Parity NONE Stop bits 1 NMEA Auto File (full path) Height Sampling Disc 1 Streams: resource loader / mountpoint decoder lat long nmee ntrip bytes 1 ntrip.gnsslab.cn:2101/PADO0 RTCM_2.3 45.41 11.90 no 2 0 byte(s)	Port settings to feed a serial connected receiver.
Baud rate 960 Flow control OFF Formation of the state of	Mountpoint PADO0
Data bits 8 Parity NONE Stop bits 1 NMEA Auto File (full path) Height Sampling Sec Streams: resource loader / mountpoint decoder lat long nme; ntrip bytes 1 ntrip.gnsslab.cn:2101/PADO0 RTCM_2.3 45.41 11.90 no 2 0 byte(s)	Port name COM2
NMEA Auto File (full path) Height Sampling D sec Image: Streams: resource loader / mountpoint decoder lat long nmex ntrip bytes 1 ntrip.gnsslab.cn:2101/PADO0 RTCM_2.3 45.41 11.90 no 2 0 byte(s) Log Throughput Latency PPP Plot Image: Stream of the second sec	Baud rate 9600 Flow control OFF
Streams: resource loader / mountpoint decoder lat long nmex ntrip bytes 1 ntrip.gnsslab.cn:2101/PADO0 RTCM_2.3 45.41 11.90 no 2 0 byte(s)	Data bits 8 Parity NONE Stop bits 1
1 ntrip.gnsslab.cn:2101/PADO0 RTCM_2.3 45.41 11.90 no 2 0 byte(s)	NMEA Auto File (ful path) Height Sampling 0 sec
1 ntrip.gnsslab.cn:2101/PADO0 RTCM_2.3 45.41 11.90 no 2 0 byte(s)	
1 ntrip.gnsslab.cn:2101/PADO0 RTCM_2.3 45.41 11.90 no 2 0 byte(s)	
Log Throughput Latency PPP Plot	Streams: resource loader / mountpoint decoder lat long nmex ntrip bytes
	1 ntrip.gnsslab.cn:2101/PADO0 RTCM_2.3 45.41 11.90 no 2 0 byte(s)
	Log Throughput Latency PPP Plot
Add Stream Delete Stream Map Start Stop Help?=Shift+F1	

Figure 2: Ntrip Client Demo



2.4. Add Stream Window

1. Click **"Add Stream"** to open the "Add Stream" window, and then click **"Caster"** to open the "Add Stream from Caster" window.

	(BNC) Version 2.12.2					- - x
e Help						
RINEX Observations	RINEX Ephemeris	RINEX Editing & QC	SP3 Comparison	Broadcast Corrections	Feed Engine S	erial Output
Port settings to feed	a serial connected receiv	er.				
1ountpoint						
ort name						
Baud rate	9600 -	Flow control OFF	·			
Data bits	8 🔻	Parity NONE	 Stop bits 			
MEA	Auto 👻	ile (full path)		Height	Samplin	g 0 sec 🗼
treams: resourc	e loader / mountpoi		stream(s) coming	IDP port Serial port	Cancel	
.og Throughput	Latency PPP Plo					
1						
d Stream Delete St	ream Map Start Sto	PP	Help?=Shift+F	1		

Figure 3: Add Stream Window

2. Click "Get table" to display streams.

Caster host	ntrip.gnsslab.cn 🔻	Caster port	2101	Casters table	Show
Vser	alvin	Password	••••	Ntrip Version	2 🔻





- **Caster host and Caster port:** IP address and port of NtripCaster, the selection of NtripCaster is arbitrary, but users must ensure that whether their network can visit IP address of NtripCaster. Please note that different NtripCasters have different data streams. These NtripCasters listen at ports "80" and "2101". The detailed information of NtripCaster is in link: <u>http://ntrip.org</u>.
- User and Password: Users must apply for user ID and password from NtripCaster.

The stream is shown as following figure.

Cas	ter host ntr	ip.gnsslab.cn	•	Caster port	2101	Casters	s table S	how
	User alvi	n		Password	•••••	Ntrip V	ersion 2	•
	mountpoint	identifier	format	format	details	:arrie	system	net ^
139	OUS20	Dunedin	RTCM 3.0	1004(1),1006(1	0),1007(10),	2	GPS+GLO	IGS
140	OUS27	Dunedin	RTCM 3.2	1007(10),1008(10),1019(15)	2	GPS+GL	IGS
141	PADO0	Padova	RTCM 2.3	1(1),3(10),18(1)	,19(1),23(10)	2	GPS	IGS
142	PDELO	Ponta-Del	RTCM 3.0	1004(1),1006(6	0),1008(60),	2	GPS+GLO	IGS
143	PENC0	Penc	RTCM 3.0	1004(1),1006(6	0),1008(60),	2	GPS+GLO	IGS
144	POTSO	Potsdam	RTCM 3.0	1004(1),1006(1	0),1007(10),	2	GPS+GLO	IGS
145	POTS7	Potsdam	RTCM 3.2	1007(10),1008(10),1019(15)	2	GPS+GL	IGS
146	POVE0	Porto_Velho	RTCM 3.0	1004(1),1006(1	0),1008(10),	2	GPS+GLO	IGLC
•								

Figure 5: Stream Table

3. Select one **"mountpoint"** and then click **"Select"** to add stream.



2.5. Serial Output Window

😽 BKG Ntri	p Client (BNC) Ver	sion 2.12.2				
File Help						
ervations	RINEX Ephemeris	RINEX Editing & QC	SP3 Comparison	Broadcast Correction	ns Feed Engine Se	erial Output Outages
Port setting	gs to feed a serial con	nected receiver.				
Mountpoint	t PADO0					
Port name	COM2					
Baud rate	9600	 Flow cont 	rol OFF 🔻			
Data bits	8 -	Pari	ity NONE -	Stop bits 1 🔻		
NMEA	Auto	▼ File (full pat	h)		Height	Sampling 0 sec 🔶
Stream	ns: resource load	er / mountpoint	decoder lat	long ni	ne: ntrip bytes	
1 ntrip.gn	nsslab.cn:2101/PAD	00	RTCM_2.3 45.4	1 11.90 no	2 0 byte(s)	
Log Th	nroughput Latency	/ PPP Plot				
				0		
Add Stream	Delete Stream Map	Start Stop	H	lelp?=Shift+F1		

Figure 6: Serial Output Window

- **Mountpoint:** Optional. Enter a "**Mountpoint**" to forward its corresponding stream to serial connected GNSS receiver. When selecting one of the serial communication options listed below, make sure that users' selection can be configured to serial connected receiver.
- **Port Name:** Mandatory if **"Mountpoint"** is set. Enter the serial **"Port name"** selected on users' host for communication with the serial connected receiver. Valid port names are Windows COM1 and COM2.
- **Baud rate:** Choose the right baud rate according to users' test environment.
- Flow Control: Mandatory if "Mountpoint" is set. Select a "Flow control" for the serial output link. Please note that users' selection must equal to the flow control configured to the serial connected device. Select "OFF" if users are not clear about this.
- **Parity:** Mandatory if "**Mountpoint**" is set. Select the "**Parity**" for the serial output link. Please note that parity is often set as "**NONE**".
- **Data Bits:** Mandatory if **"Mountpoint"** is set. Select the number of **"Data bits"** for the serial output link. Please note that **"8"** data bits are often used.



- **Stop Bits:** Mandatory if "**Mountpoint**" is set. Select the number of "**Stop bits**" for the serial output link. Note that "1" stop bit is often used.
- NMEA: Mandatory for VRS streams. Select "Auto" to automatically forward all NMEA-GGA messages coming from users' serial connected GNSS receiver to the Ntrip Broadcaster and/or save them in a file.

2.6. Quectel Test Environment

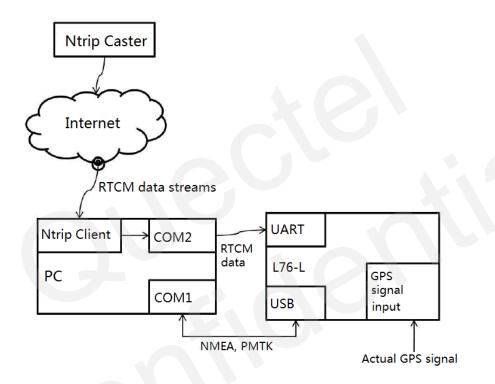


Figure 7: Quectel Test Environment

- Test model: L76-L
- NtripCaster: ntrip.gnsslab.cn (located in Wuhan, China)
- Streams: PADO0, RTCM format version 2.3 (NtripSources located in Padova, Italy)

NOTE

Because there is no NtripSources near Quectel, we had to select the NtripSources far away from Quectel.



2.7. RTCM Test Procedures

- Ntrip COM Port Setting: Baud rate: 9600 Port number: COM2 Connect COM2 to UART of L76-L
- 2. Select the data streams: PADO0. And then click "START".
- 3. Output L76-L GPS signal port with actual GPS signal.
- 4. PowerGPS connection.
- Issue the following commands in PowerGPS

 --PMTK104
 --PMTK301,1
 - --PMTK250,1,1,9600
- 6. Wait for position fixing.

2.8. Fix Position Without RTCM Input

The positioning information will be shown below without the RTCM data input.

Inform	ation LANATA LAN	K Binow L Boot al	
monn	BUON NMEA M	K Binary Packet	
GGA	UTC Time	08:55:39.000	
GGA	Latitude	31.84612833 N	
GGA	Longitude	117.19859833 E	
GGA	Pos Fix	Valid DGPS	
GGA	Num of SV Used	11	
GGA	HDOP	1.090	
GGA	Altitude (m)	70.900	
RMC	UTC Date	2016-11-09	
GGA	DGPS Age (s)	0.0	
GGA	DGPS ID	0	
GSV	Sat in View	18	
GGA	Geoid Offset (m)	0.000	
GSA	Op Mode	Auto 2D/3D	
GSA	Fixing Mode	3D	-





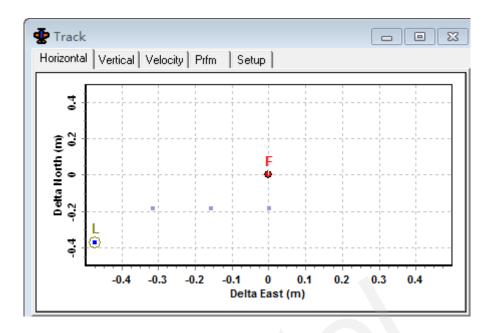


Figure 9: Position Fixing

As seen from the above two figures, using strong GPS signal can stabilize positioning.

2.9. Fix Position with RTCM Input

The positioning information will be shown below with the RTCM data input.

👳 NM	EA Text		83
Informa	tion NMEA MT	K Binary Packet	
GGA	UTC Time	08:49:08.000	
GGA	Latitude	31.84576333 N	
GGA	Longitude	117.19803667 E	
GGA	Pos Fix	Valid DGPS	
GGA	Num of SV Used 17		
GGA	HDOP	0.630	
GGA	Altitude (m)	109.100	
RMC	UTC Date	2016-11-09	
GGA	DGPS Age (s)	20	
GGA	DGPS ID	37	
GSV	Sat in View	23	
GGA	Geoid Offset (m)	0.000	
GSA	Op Mode	Auto 2D/3D	
GSA	Fixing Mode	3D	Ŧ
•		4	

Figure 10: NMEA Text with RTCM Data Input



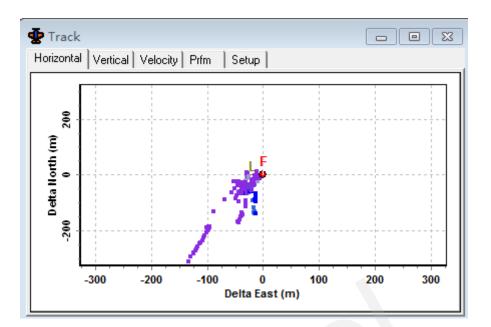


Figure 11: Position Fixing

As seen from the above figures, GPS mode is DGPS, DGPS ID (Reference Station Number) is 37, and DGPS Age is 2.0s.

But we found that with the RTCM data input, the positioning accuracy does not get better.

Reason: The reference station (located in Padova, Italy) is far away from user, so the RTCM data works as interference and cannot improve positioning accuracy.

Conclusion: NtripSources which are selected should be near users because interference in NtripSources is almost similar to interference in users.



3 Customer FAQs

3.1. RTCM Versions Supported by Quectel

Question:

Which versions does Quectel GNSS series module support? And does it support RTK-GPS?

Answer:

Quectel GNSS series module supports RTCM function and supports these RTCM message types: type 1, 2, 3, and 9, and these four message types are all defined in *RTCM SC-104 V2.x Specification* (V2.x represents V2.0, V2.1, V2.2, V2.3). Quectel GNSS series module does not support RTCM V3.x version and RTK.

3.2. UART Settings

Question:

We found that L76-L's RTCM input port is UART (PIN16, PIN17), while the NMEA output port is USB (PIN2, PIN3), can the RTCM input port be changed as USB?

Answer:

Sorry, it's not feasible. Only UART (PIN16, PIN17) can receive RTCM data. We must use Quectel GNSS series module whose COM port can support RTCM input for testing.

3.3. DGPS Information in NMEA

Question:

How does Quectel GNSS series module know that RTCM data has been received? Does NMEA sentence show something about getting RTCM data?

Answer:

GPGGA can show some RTCM information such as DGPS Age and DGPS ID.



3.4. Accuracy is Improved Less

Question:

Reference station is located in Incheon (40km far away from user) and RTCM data is received over the Internet. RTCM version 2.0 and 2.3 are tested, but the positioning accuracy is improved less.

Answer:

Correction method is defined in *RTCM SC-104 Specification*.

Correction Formula: PR(t)=PRM(t)+PRC(t).

GNSS receiver only gets PRC (Pseudorange Correction) from RTCM messages and applies it to PRM (Pseudorange Measurement), receiver cannot guarantee the validity of the data. So if accuracy is improved less, there may be two reasons:

- 1. Reference station is far away from user.
- 2. Reference station generates RTCM message incorrectly.



4 Appendix A References

Table 1: Related Documents

SN	Document Name	Remark
[1]	RTCM SC-104 v2.x Specification	Supports RTCM versions of 2.0, 2.1, 2.2 and 2.3
[2]	RTCM SC-104 Specification	Supports RTCM versions of 2.0, 2.1, 2.2, 2.3 and 3.x

Table 2: Terms and Abbreviations

Abbreviation	Description
DGPS	Differential Global Positioning System
FAQ	Frequently Asked Questions
GGA	Global Positioning System Fix Data
GNSS	Global Navigation Satellite System
GSV	GNSS Satellites in View
GPS	Global Positioning System
HOOP	Horizontal Dilution of Precision
ID	Identification
IP	Internet Protocol
NMEA	National Marine Electronics Association
NTRIP	Networked Transport of RTCM via Internet Protocol
PC	Personal Computer
PDA	Personal Digital Assistant
PMTK	Private Protocol of MTK



PR	Pseudorange
PRC	Pseudorange Correction
PRM	Pseudorange Measurement
RMC	Recommended Minimum Position Data
RTCM	Radio Technical Commission for Maritime services
RTK	Real-time Kinematic
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
UTC	Coordinated Universal Time
VRS	Virtual Reference Station