

L89 R2.0&LC29H (AA,BS)&LC79H (AL) EASY&EPOC Difference Introduction

GNSS Module Series

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About the Document

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1 Introduction

Quectel L89 R2.0, LC29H (AA, BS) and LC79H (AL) modules support EASY (Embedded Assist System) or EPOC (Enhanced Prediction Orbit on Chip) function that significantly improves the module's TTFF. However, owing to technology and constellation updates, the original EASY function has been upgraded to EPOC function. Consequently, EASY will no longer be supported in subsequent firmware versions.

This document outlines the differences between EASY and EPOC functions and their respective applications. The supported modules for these functions include:

Table 1: Applicable Modules

Module Series	Model	Software Version	Function
L89 R2.0	L89 (HA)	L89HANR01A07S and previous versions	EASY
	L89 (HB)	L89HBNR01A01S	
LC29H	LC29H (AA)	LC29HAANR11A01S and previous versions	
	LC29H (BS)	LC29HBSNR11A01S and previous versions	
LC79H	LC79H (AL)	LC79HALNR11A01S and previous versions	
Other software versions of the applicable modules			EPOC

1.1 Overview of EASY

EASY is a solution designed to enhance the TTFF performance. It is an internal module application that predicts satellite orbits based on the received ephemeris data decoded from the ephemeris data broadcast by the satellites themselves. This way, the module does not need external network connectivity. Upon receiving the updated broadcast ephemeris data, the EASY function is automatically activated to predict satellite orbits for the following 3 days. EASY enters a standby state upon completion of the 3-day extension of satellite orbit prediction for all available SVs.

EASY only supports GPS constellation. The figure below illustrates how the EASY function is activated and utilized by the module for orbit prediction during free time when it is not processing internal tasks. The EASY aiding data supplements the lack of the EPO (Extended Prediction Orbit) aiding data in scenarios

where the module may not have access to an external network and server derived predictions.

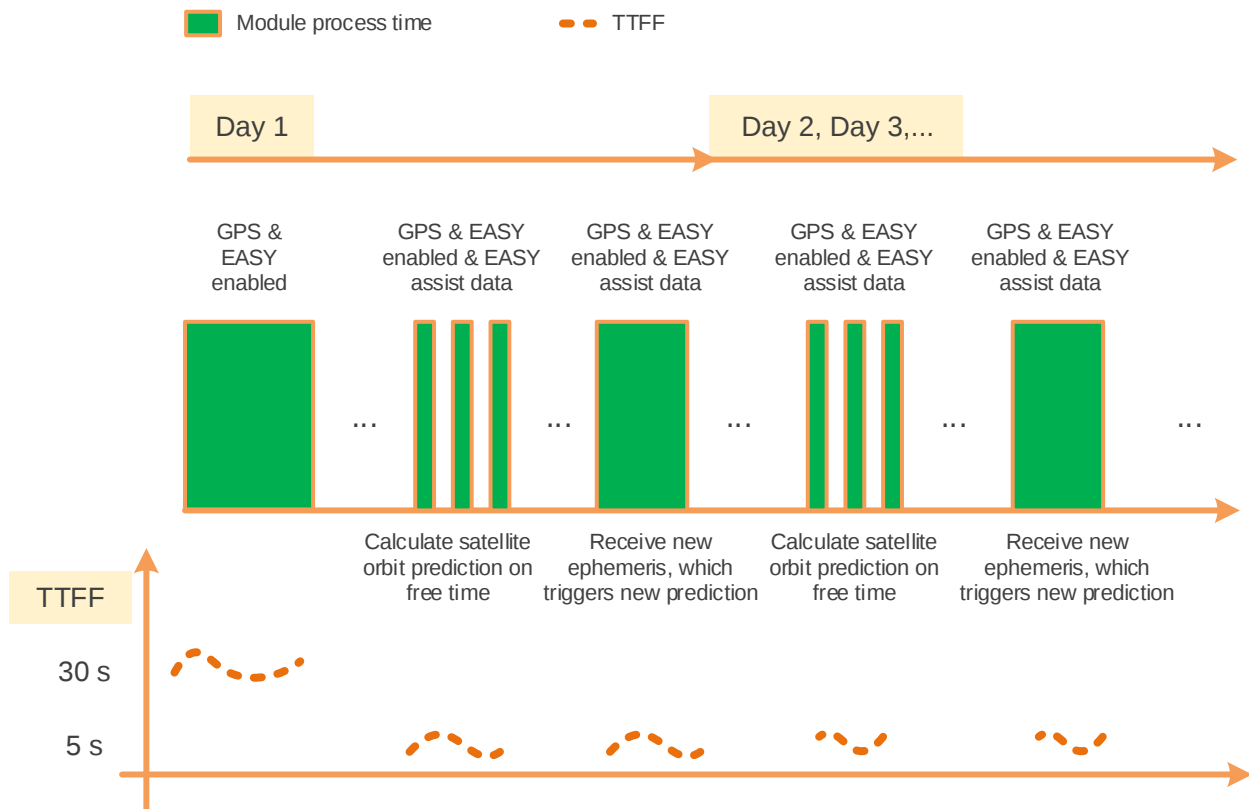


Figure 1: Mechanism of EASY Function

1.2 Overview of EPOC

EPOC is another internal module application designed to improve the TTFF performance by predicting GNSS constellation orbits using the received broadcast ephemeris data. EPOC aiding data serves as an alternative AGNSS method aimed at speeding up TTFF when the loss of EPOC aiding data is caused by unavailability of external network connectivity.

The figure below illustrates the operational mechanism of EPOC. On Day 1, TTFF is approximately 30 seconds without EPOC aiding data. Once the broadcast ephemerides are received, EPOC automatically activates the 3-day satellite orbit prediction process. Over the subsequent 72 hours, EPOC accelerates TTFF and ensures precise positioning. After completing the orbit prediction process for all available broadcast ephemerides, EPOC transitions to standby state until new broadcast ephemeris data becomes available.

EPOC in contrast to EASY supports three options of constellation configurations: GPS only, GPS + Galileo, and GPS + BDS (MEO and IGSO). In each configuration, the module can receive and process data from

up to 40 satellites. If a particular constellation search is not turned on while EPOC prediction is enabled, the orbit will not be predicted for that constellation.

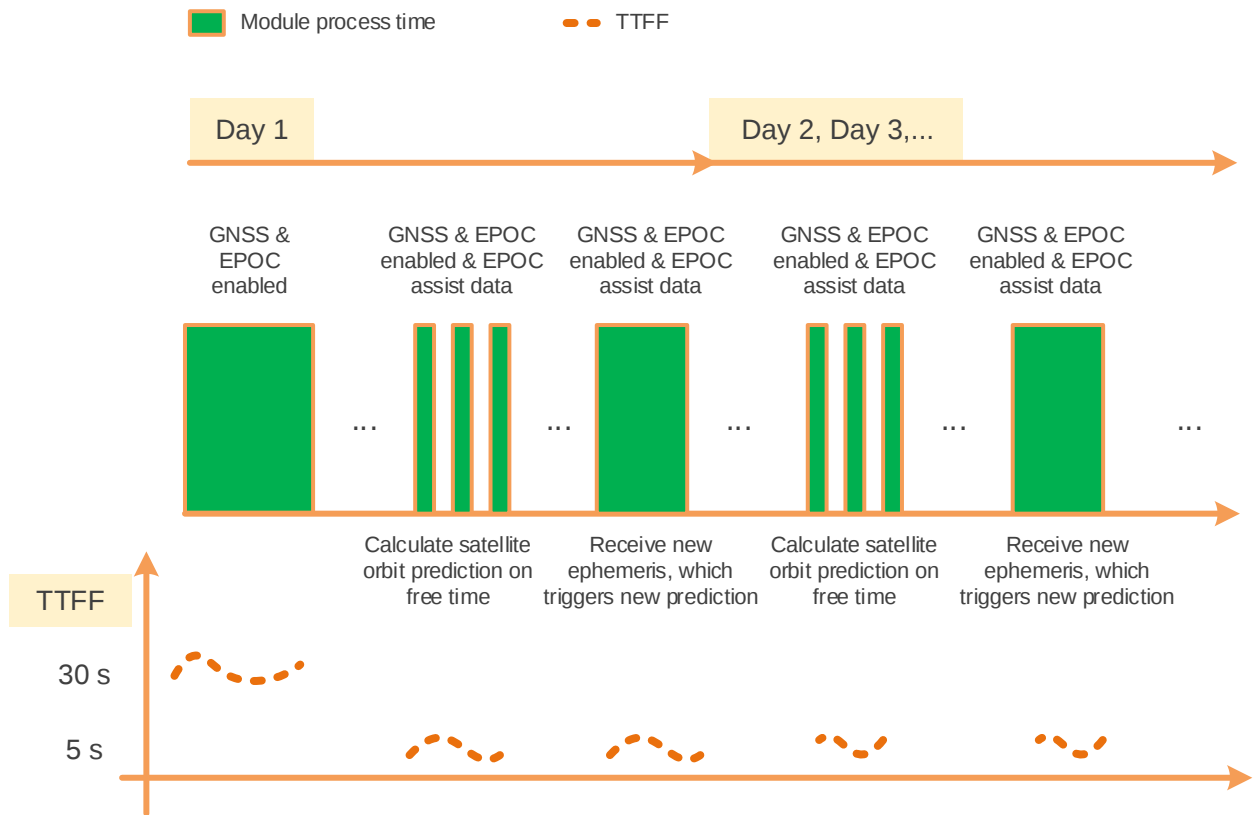


Figure 2: Mechanism of EPOC Function

2 Differences

Both EPOC and EASY can predict satellite orbits for the upcoming 3 days. However, the main differences between them are:

- EASY only supports GPS, whereas EPOC supports GPS, Galileo, and BDS;
- EASY supports storing 1, 2, or 3 days of prediction data to RTC RAM whereas EPOC supports storing 3 days;
- EPOC uses more commands/messages than EASY.

See below for details.

Table 2: EASY&EPOC Feature Differences

Feature	EASY	EPOC
Day(s) of prediction orbit automatically stored in RTC RAM	1, 2 or 3 days	3 days
Supported satellite constellations	GPS	GPS GPS + Galileo GPS + BDS (MEO and IGSO)

Table 3: EASY&EPOC Message Differences

Feature	EASY	EPOC
Enable or disable EASY/EPOC	\$PAIR490	\$PAIR496
Configure constellation(s)	-	\$PAIR498
Clear data from NVM	-	\$PAIR507
Get status of EASY/EPOC function	\$PAIR491	\$PAIR508
Get prediction status	\$PAIR491	\$PAIR509
Save current navigation data from RTC RAM to NVM	\$PAIR511	\$PAIR511
Clear navigation data in both RTC RAM and NVM	\$PAIR512	\$PAIR512
Save current configuration from RTC RAM to NVM	\$PAIR513	\$PAIR513

3 Messages

3.1. EASY-Related Messages

3.1.1. Packet Type: 490 PAIR_EASY_ENABLE

Enables/disables EASY function.

Type:

Set

Synopsis:

```
$PAIR490,<Enabled>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Enabled>	Numeric	-	EASY function setting. 0 = Disable <u>1</u> = Enable

Result:

Returns **\$PAIR001** message. For details about **\$PAIR001**, see [documents \[1\], \[2\], or \[3\] protocol specifications](#).

Example:

```
$PAIR490,1*2A
$PAIR001,490,0*36
```

3.1.2. Packet Type: 491 PAIR_EASY_GET_STATUS

Gets the status of EASY function and prediction status (EASY data extension status).

Type:

Get

Synopsis:

```
$PAIR491*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **\$PAIR001** message and the query result. For details about **\$PAIR001**, see [documents \[1\], \[2\], or \[3\] protocol specifications](#).

Query result message format:

```
$PAIR491,<Enabled>[,<Status>]*<Checksum><CR><LF>
```

Parameters included in the result:

Field	Format	Unit	Description
<Enabled>	Numeric	-	EASY function setting. 0 = Disabled 1 = Enabled
<Status>	Numeric	-	EASY data extension status. 0 = Not finished 1 = 1-day extension finished 2 = 2-day extension finished 3 = 3-day extension finished

Example:

```
$PAIR491*36
$PAIR001,491,0*37
$PAIR491,1,0*37
```

NOTE

If EASY function is disabled, only the value of **<Enabled>** will be returned after executing this command.

3.2. EPOC-Related Messages

3.2.1. Packet Type: 496 PAIR_EPOC_ENABLE

Enables/disables EPOC function.

Type:

Set

Synopsis:

```
$PAIR496,<Enabled>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Enabled>	Numeric	-	EPOC function setting. 0 = Disable <u>1</u> = Enable

Result:

Returns **\$PAIR001** message. For details about **\$PAIR001**, see [documents \[1\], \[2\], or \[3\] protocol specifications](#).

Example:

```
$PAIR496,1*2C
$PAIR001,496,0*30
```

3.2.2. Packet Type: 498 PAIR_EPOC_SET_CONFIG

Sets EPOC constellation configuration.

Type:

Set

Synopsis:

```
$PAIR498,<Constellation>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Constellation>	Numeric	-	EPOC constellation configuration. Default configuration: GPS. Bit 0 = GPS Bit 1 = Galileo Bit 2 = BDS

Result:

Returns **\$PAIR001** message. For details about **\$PAIR001**, see [documents \[1\], \[2\], or \[3\] protocol specifications](#).

Example:

```
$PAIR498,1*22
$PAIR001,498,0*3E
```

NOTE

<Constellation> is a decimal value. Only GPS, GPS + Galileo, and GPS + BDS are available.

3.2.3. Packet Type: 507 PAIR_EPOC_CLEAR_DATA

Clears all EPOC data from NVM.

Type:

Command

Synopsis:

```
$PAIR507*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **\$PAIR001** message. For details about **\$PAIR001**, see [documents \[1\], \[2\], or \[3\] protocol specifications](#).

Example:

```
$PAIR507*38
$PAIR001,507,0*39
```

3.2.4. Packet Type: 508 PAIR_EPOC_GET_STATUS

Gets the status of EPOC function and constellation configuration.

Type:

Get

Synopsis:

```
$PAIR508*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **\$PAIR001** message and the query result. For details about **\$PAIR001**, see [documents \[1\]. \[2\]. or \[3\] protocol specifications](#).

Query result message format:

```
$PAIR508,<Enabled>,<Constellation>*<Checksum><CR><LF>
```

Parameters included in the result:

Field	Format	Unit	Description
<Enabled>	Numeric	-	EPOC function setting. 0 = Disabled 1 = Enabled
<Constellation>	Numeric	-	EPOC constellation configuration. Bit 0 = GPS Bit 1 = Galileo Bit 2 = BDS

Example:

```
$PAIR508*37
$PAIR001,508,0*36
$PAIR508,1,1*37
```

3.2.5. Packet Type: 509 PAIR_EPOC_GET_PREDICTION_STATUS

Gets EPOC prediction status.

Type:

Get

Synopsis:

```
$PAIR509,<Constellation>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Constellation>	Numeric	-	EPOC constellation configuration. Bit 0 = GPS Bit 1 = Galileo Bit 2 = BDS

Result:

Returns **\$PAIR001** message and the query result. For details about **\$PAIR001**, see [documents \[1\]. \[2\]. or \[3\] protocol specifications](#).

Query result message format:

```
$PAIR509,<Status>,<Constellation>,<SatelliteStatus>*<Checksum><CR><LF>
```

Parameters included in the result:

Field	Format	Unit	Description
<Status>	Numeric	-	Prediction status. 1 = Prediction in progress. 2 = All received ephemeris data have been calculated for prediction. 3 = No valid ephemeris data.
<Constellation>	Numeric	-	EPOC constellation configuration. Bit 0 = GPS Bit 1 = Galileo Bit 2 = BDS
<SatelliteStatus>	Hexadecimal	-	Satellite available bitmask. Bit number represents satellite ID and "1" in a specific bit position indicates that the orbit prediction for the corresponding satellite is complete.

Example:

```
$PAIR509,1*2B
$PAIR001,509,0*37
$PAIR509,2,1,000000000000D2D2C*6A
```

NOTE

<SatelliteStatus>: Satellite number in bitwise format. For example, “000000000000D2D2C” indicates that the 3-day predictions for satellites 3, 4, 6, 9, 11, 12, 14, 17, 19, and 20 have been completed.

3.3. EASY&EPOC-Related Messages

3.3.1. Packet Type: 511 PAIR_NVRAM_SAVE_NAVIGATION_DATA

Saves current navigation data from RTC RAM to NVM.

Type:

Command

Synopsis

```
$PAIR511*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **\$PAIR001** message. For details about **\$PAIR001**, see [documents \[1\], \[2\], or \[3\] protocol specifications](#).

Example:

```
//If the position fix rate is 1 Hz.
$PAIR511*3F
$PAIR001,511,0*3E

//If the position fix rate exceeds 1 Hz. For L89 R2.0, executing $PAIR382 is not required.
$PAIR382,1*2E
$PAIR001,382,0*32
$PAIR003*39
$PAIR001,003,0*38
```

```
$PAIR511*3F
$PAIR001,511,0*3E
$PAIR002*38
$PAIR001,002,0*39
```

NOTE

1. If the backup domain cannot be powered after the power supply of the module is cut off, you must send **\$PAIR511** every time the parameters are modified.
2. If the position fix rate exceeds 1 Hz, power off the GNSS system with **\$PAIR382,1*2E** (not required for L89 R2.0) and **\$PAIR003*39** in sequence before sending this command. After sending **\$PAIR511*3F**, re-power the module with **\$PAIR002*38**. This limitation does not apply to position fix rates below 1 Hz.

3.3.2. Packet Type: 512 PAIR_NVRAM_CLEAR_NAVIGATION_DATA

Clears navigation data in both RTC RAM and NVM.

Type:

Command

Synopsis

```
$PAIR512*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **\$PAIR001** message. For details about **\$PAIR001**, see [documents \[1\], \[2\], or \[3\] protocol specifications](#).

Example:

```
$PAIR512*3C
$PAIR001,512,0*3D
```

3.3.3. Packet Type: 513 PAIR_NVRAM_SAVE_SETTING

Saves current configuration from RTC RAM to NVM.

Type:

Command

Synopsis:

```
$PAIR513*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **\$PAIR001** message. For details about **\$PAIR001**, see [documents \[1\], \[2\], or \[3\] protocol specifications](#).

Example:

//If the position fix rate is 1 Hz.

\$PAIR513*3D

\$PAIR001,513,0*3C

//If the position fix rate exceeds 1 Hz. For L89 R2.0, executing **\$PAIR382** is not required.

\$PAIR382,1*2E

\$PAIR001,382,0*32

\$PAIR003*39

\$PAIR001,003,0*38

\$PAIR513*3D

\$PAIR001,513,0*3C

\$PAIR002*38

\$PAIR001,002,0*39

NOTE

1. If the backup domain cannot be powered after the power supply of the module is cut off, you must send **\$PAIR513** every time the parameters are modified.
2. If the position fix rate exceeds 1 Hz, power off the GNSS system with **\$PAIR382,1*2E** (not required for L89 R2.0) and **\$PAIR003*39** in sequence before sending this command. After sending **\$PAIR513*3D**, re-power the module with **\$PAIR002*38**. This limitation does not apply to position fix rates below 1 Hz.

4 Applications

This chapter explains how to use EASY and EPOC functions, which have similar usage steps.

4.1. EASY Application

The recommended process for utilizing the EASY function is illustrated below:

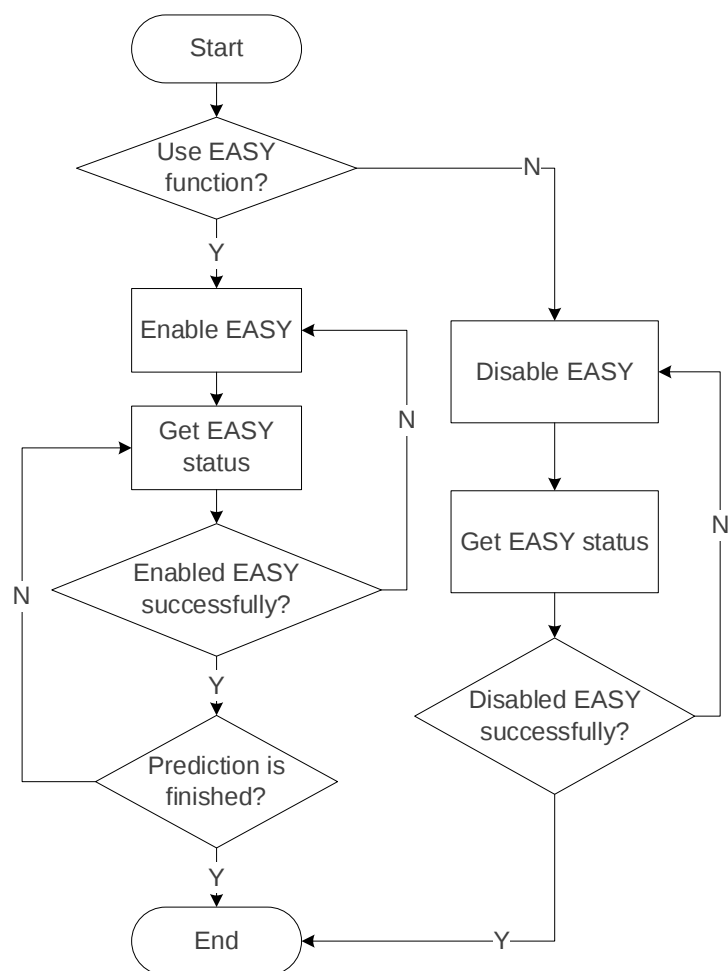


Figure 3: Recommended Process for Using EASY

Example:

//1. Enable EASY function.

//Enable EASY:

\$PAIR490,1*2A

\$PAIR001,490,0*36

//Get EASY status:

\$PAIR491*36

\$PAIR001,491,0*37

\$PAIR491,1,0*37

//2. Disable EASY function.

//Disable EASY:

\$PAIR490,0*2B

\$PAIR001,490,0*36

//Get EASY status:

\$PAIR491*36

\$PAIR001,491,0*37

\$PAIR491,0,0*36

NOTE

Performing “Enable EASY” is optional since EASY is enabled by default.

4.2. EPOC Application

The recommended process for utilising the EPOC function is illustrated below:

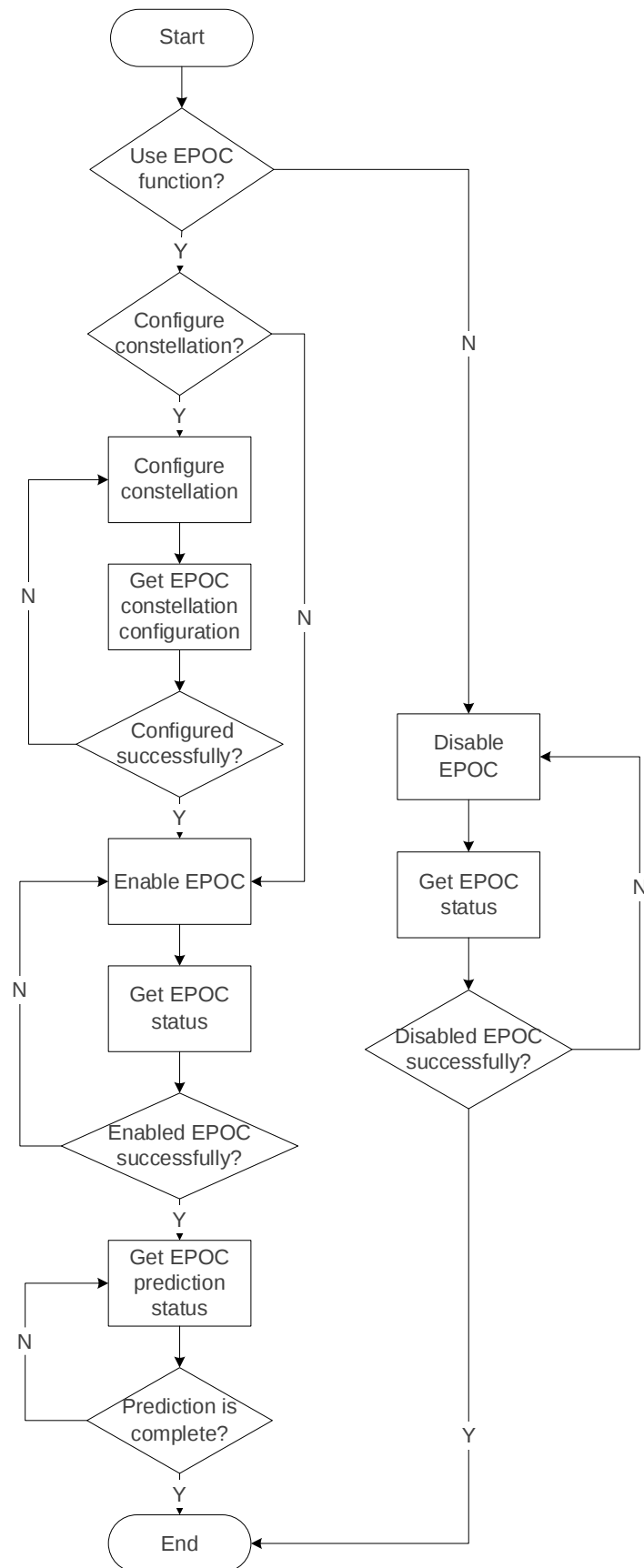


Figure 4: Recommended Process for Using EPOC

Example:

```
//1. Enable EPOC function.
//Set EPOC constellation configuration:
$PAIR498,1*22
$PAIR001,498,0*3E

//Get EPOC constellation configuration:
$PAIR508*37
$PAIR001,508,0*36
$PAIR508,0,1*36

//Enable EPOC:
$PAIR496,1*2C
$PAIR001,496,0*30

//Get EPOC status:
$PAIR508*37
$PAIR001,508,0*36
$PAIR508,1,1*37

//Get EPOC prediction status:
$PAIR509,1*2B
$PAIR001,509,0*37
$PAIR509,2,1,000000000000D2D2C*6A

//2. Disable EPOC function.
//Disable EPOC:
$PAIR496,0*2D
$PAIR001,496,0*30

//Get EPOC status:
$PAIR508*37
$PAIR001,508,0*36
$PAIR508,0,1*36
```

NOTE

Performing “Enable EPOC” is optional since EPOC is enabled by default.

5 Appendix A References

Table 4: Related Documents

Document Name
[1] Quectel L89 R2.0 GNSS Protocol Specification
[2] Quectel LC29H(BS) GNSS Protocol Specification
[3] Quectel LC29H Series&LC79H(AL) GNSS Protocol Specification

Table 5: Terms and Abbreviations

Abbreviation	Description
EASY	Embedded Assist System
EPO	Extended Prediction Orbit
EPOC	Enhanced Prediction Orbit on Chip
GNSS	Global Navigation Satellite System
IGSO	Inclined Geosynchronous Orbit
MEO	Medium Earth Orbit
NVM	Non-Volatile Memory
SV	Satellites in View
TTFF	Time To First Fix

6 Appendix B Special Characters

Table 6: Special Characters

Special Character	Description
<CR>	Carriage return character.
<LF>	Line feed character.
<...>	Parameter name. Angle brackets do not appear in the message.
[...]	Optional field of a message. Square brackets do not appear in the message.
{...}	Repeated field of a message. Curly brackets do not appear in the message.
<u>Underline</u>	Default setting of a parameter.