LC29D GNSS Protocol Specification

GNSS Module Series

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Quectel Wireless Solutions Co., Ltd.
Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China
Tel: +86 21 5108 6236
Email: info@quectel.com

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About the Document

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1 Introduction

Quectel LC29D GNSS module supports GPS, GLONASS, BeiDou, Galileo, QZSS and NavIC (IRNSS) constellations. Simultaneous tracking of GPS L1 C/A and L5, GLONASS L1, BeiDou B1I and B2a, QZSS L1 C/A and L5, Galileo E1 and E5a and NavIC L5 frequency bands provides fast and accurate acquisition and makes this module an ideal solution for positioning and navigation in various vertical markets.

This document describes the software commands that are needed to control and modify the module configuration. LC29D can be controlled and configured through Bream messages defined by the chipset supplier. To report GNSS information, the module supports output messages in NMEA 0183 standard protocol.

This document is applicable to the following Quectel modules:

- LC29D (A)
- LC29D (B)
- LC29D (C)

NOTE

1. Only use the commands listed in this document. Quectel assumes no responsibility if you use commands that are not listed in this document.
2. Only LC29D (B) supports BeiDou B2a.

2 NMEA Protocol

2.1. Structure of NMEA Protocol Messages

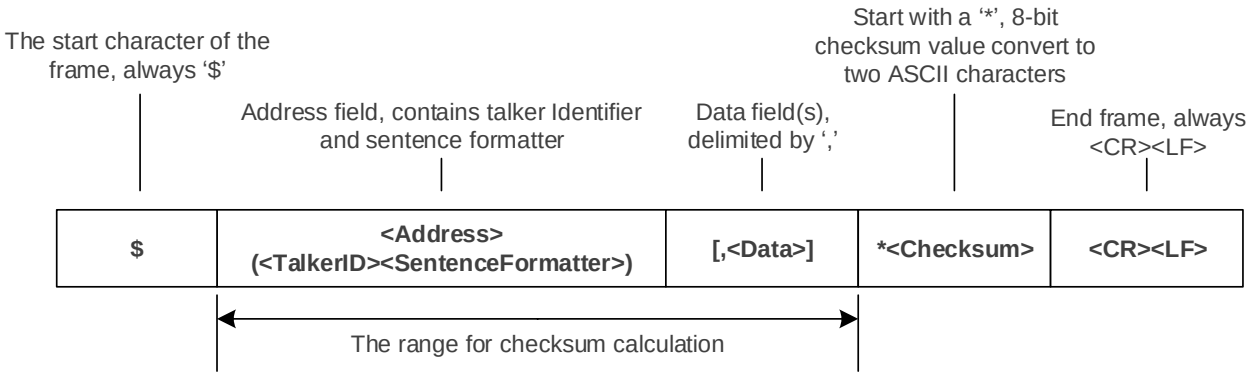

Figure 1: Structure of the NMEA Protocol Message

Table 1: Structure of the NMEA Protocol Message

Field	Description
$	Start of the sentence (Hex 0x24).
Address	**In Standard Messages:** In NMEA standard messages, this field consists of a two-character talker identifier (TalkerID) and a three-character sentence formatter (SentenceFormatter). The talker identifier serves to define the nature of the data being transmitted. For more information on the TalkerID. See *Table 2: NMEA Talker ID.* The sentence formatter is used to define the format and the type of data. **In Proprietary Messages:** In NMEA proprietary messages, this field consists of the proprietary character **P** followed by a three-character Manufacturer's Mnemonic Code, used to identify the TALKER issuing a proprietary sentence, and any additional characters as required.
Data	Data fields, delimited by comma (,). Variable length (depends on the NMEA message type).

Checksum	The checksum field follows the checksum delimiter character *****. The checksum is the 8-bit exclusive OR of all characters in the sentence, including the comma (**,**) delimiters, between but not including the **$** and the ***** delimiters.
<CR><LF>	End of the sentence (Hex 0x0D 0x0A).

Table 2: NMEA Talker ID

GNSS Constellation Configuration	TalkerID (NMEA V4.11)
GPS	GP
GLONASS	GL
Galileo	GA
BeiDou	GB
QZSS	GQ
NavIC (IRNSS)	GI
Combination of multiple satellite systems	GN

2.2. Standard Messages

This chapter introduces the NMEA 0183 V4.11 standard messages supported by the module.

2.2.1. RMC

Recommended Minimum Specific GNSS Data. Time, date, position, course, and speed data provided by a GNSS receiver.

Type:

Output

Synopsis:

```
$<TalkerID>RMC,<UTC>,<Status>,<Lat>,<N/S>,<Lon>,<E/W>,<SOG>,<COG>,<Date>,<MagVar>,<MagVarDir>,<ModeInd>,<NavStatus>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Example	Description
<TalkerID>	String, 2 characters	-	$GN	Talker identifier. See *Table 2: NMEA Talker ID.*
RMC	String, 3 characters	-	RMC	Recommended Minimum Specific GNSS Data.
<UTC>	hhmmss.ss	-	053402.00	UTC of position fix. hh: Hours (00–23) mm: Minutes (00–59) ss: Seconds (00–59) ss: Decimal fraction of seconds
<Status>	Character	-	A	The status of the positioning system. A = Data valid V = Invalid D = Differential
<Lat>	ddmm.mmmmmm	-	3149.281114	Latitude. dd: Degrees (00–90) mm: Minutes (00–59) mmmmmm: Decimal fraction of minutes Note that this field is empty in case of an invalid value.
<N/S>	Character	-	N	Latitude direction. N = North S = South Note that this field is empty in case of an invalid value.
<Lon>	dddmm.mmmmmm	-	11706.921937	Longitude. ddd: Degrees (000–180) mm: Minutes (00–59) mmmmmm: Decimal fraction of minutes Note that this field is empty in case of an invalid value.
<E/W>	Character	-	E	Longitude direction. E = East W = West Note that this field is empty in case of an invalid value.
<SOG>	Numeric	Knot	000.0	Speed over ground. Variable length. Note that this field is empty in case of an invalid value.
<COG>	Numeric	Degree	-	Course over ground. Variable length.

				The maximum value is 359.9. Note that this field is empty in case of an invalid value.
<Date>	ddmmyy	-	100420	Date. dd: Day of month mm: Month yy: Year
<MagVar>	-	-	-	Magnetic variation. Not supported.
<MagVarDir>	-	-	-	The direction of magnetic variation. Not supported.
<ModeInd>	Character	-	E	Mode indicator. A = Autonomous mode. Satellite system used in non-differential mode in position fix. D = Differential mode. Satellite system used in differential mode in position fix. Corrections from ground stations or Satellite Based Augmentation System (SBAS). E = Estimated (dead reckoning) mode. F = Float RTK. Satellite system used in RTK mode with floating integers. M = Manual input mode. N = No fix. Satellite system not used in position fix, or fix not valid. R = Real Time Kinematic (RTK). Satellite system used in RTK mode with fixed integers.
<NavStatus>	Character	-	V	Navigational status. Not supported. Always “V” (Invalid).
<Checksum>	Hexadecimal	-	*11	Checksum.
<CR><LF>	Character	-	-	Carriage return and line feed.

Example:

```
$GNRMC,053402.00,A,3149.281114,N,11706.921937,E,000.0,,100420,,,E,V*11
```

2.2.2. GGA

Global Positioning System Fix Data. Time, position, and fix-related data for a GNSS receiver.

Type:

Output.

Synopsis:

```
$<TalkerID>GGA,<UTC>,<Lat>,<N/S>,<Lon>,<E/W>,<Quality>,<NumSatUsed>,<HDOP>,<Alt>,M,<Sep>,M,<DiffAge>,<DiffStation>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Example	Description
<TalkerID>	String, 2 characters	-	$GP	Talker identifier. See *Table 2: NMEA Talker ID.*
GGA	String, 3 characters	-	GGA	Global Positioning System Fix Data.
<UTC>	hhmmss.ss	-	064635.00	UTC of position fix. hh: Hours (00–23) mm: Minutes (00–59) ss: Seconds (00–59) ss: Decimal fraction of seconds
<Lat>	ddmm.mmmmmm	-	3149.322082	Latitude. dd: Degrees (00–90) mm: Minutes (00–59) mmmmmm: Decimal fraction of minutes Note that this field is empty in case of an invalid value.
<N/S>	Character	-	N	Latitude direction. N = North S = South Note that this field is empty in case of an invalid value.
<Lon>	dddmm.mmmmmm	-	11706.911511	Longitude. ddd: Degrees (000–180) mm: Minutes (00–59) mmmmmm: Decimal fraction of minutes Note that this field is empty in case of an invalid value.

<E/W>	Character	-	E	Longitude direction. E = East W = West Note that this field is empty in case of an invalid value.
<Quality>	Numeric, 1 digit	-	1	GPS quality indicator. 0 = Fix not available or invalid. 1 = GPS SPS Mode, fix valid. 2 = Differential GPS, SPS Mode, or Satellite Based Augmentation System (SBAS), fix valid. 3 = GPS PPS Mode, fix valid. 4 = Real Time Kinematic (RTK). System used in RTK mode with fixed integers. 5 = Float RTK. Satellite system used in RTK mode with floating integers. 6 = Estimated (dead reckoning) mode.
<NumSatUsed> [1)]	Numeric, 2 digits	-	24	Number of satellites in use.
<HDOP>	Numeric	-	0.3	Horizontal dilution of precision.
<Alt>	Numeric	Meter	59.5	Altitude above mean-sea-level (geoid).
M	Character	-	M	-
<Sep>	Numeric	Meter	-3.6	Geoidal separation (the difference between the earth ellipsoid surface and the mean-sea-level (geoid) surface defined by the reference datum used in the position solution)
M	Character	-	M	-
<DiffAge>	-	-	-	Age of differential GPS data. Not supported.
<DiffStation>	-	-	-	Differential reference station ID. Not supported.
<Checksum>	Hexadecimal	-	*41	Checksum.
<CR><LF>	Character	-	-	Carriage return and line feed.

Example:

```
$GPGGA,064635.00,3149.322082,N,11706.911511,E,1,24,0.3,59.5,M,-3.6,M,,*41
```

NOTE

1. The NMEA 0183 specification indicates that the GGA message is GPS specific. However, when the receiver is configured for multi-constellations, the content of GGA message will be generated from the multi-constellation solution.
2. [1)] The NMEA 0183 specification has defined the number of satellites in use to be in the range between 00 and 12. However, in the multi-constellation solution, the number of satellites in use may exceed 12.

2.2.3. GNS

GNSS Fix Data. Fix data for single or combined satellite navigation systems (GNSS).

Type:

Output.

Synopsis:

```
$<TalkerID>GNS,<UTC>,<Lat>,<N/S>,<Lon>,<E/W>,<ModeInd>,<NumSatUsed>,<HDOP>,<Alt>,<Sep>
,<DiffAge>,<DiffStation>,<NavInd>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Example	Description
<TalkerID>	String, 2 characters	-	$GN	Talker identifier. See *Table 2: NMEA Talker ID.*
GNS	String, 3 characters	-	GNS	GNSS Fix Data.
<UTC>	hhmmss.ss	-	053148.00	UTC of position fix. hh: Hours (00–23) mm: Minutes (00–59) ss: Seconds (00–59) ss: Decimal fraction of seconds
<Lat>	ddmm.mmmmmm	-	3149.279018	Latitude. dd: Degrees (00–90) mm: Minutes (00–59) mmmmmm: Decimal fraction of minutes Note that this field is empty in case of an invalid value.
<N/S>	Character	-	N	Latitude direction.

				N = North S = South Note that this field is empty in case of an invalid value.
<Lon>	dddmm.mmmmmm	-	11706.919922	Longitude. ddd: Degrees (000–180) mm: Minutes (00–59) mmmmmm: Decimal fraction of minutes Note that this field is empty in case of an invalid value.
<E/W>	Character	-	E	Longitude direction. E = East W = West Note that this field is empty in case of an invalid value.
<ModeInd> [1)]	Character	-	AANNNN	Mode indicator. A = Autonomous mode. Satellite system used in non-differential mode in position fix. D = Differential mode. Satellite system used in differential mode in position fix. Corrections from ground stations or Satellite Based Augmentation System (SBAS). E = Estimated (dead reckoning) mode. F = Float RTK. Satellite system used in RTK mode with floating integers. M = Manual input mode. N = No fix. Satellite system not used in position fix, or fix not valid. R = Real Time Kinematic (RTK). Satellite system used in RTK mode with fixed integers.
<NumSatUsed>	Numeric	-	04	Total number of satellites in use. Range: 00–99.
<HDOP>	Numeric	-	5.3	Horizontal dilution of precision. The maximum value is 99.0.
<Alt>	Numeric	Meter	95.1	Antenna altitude above the mean sea level (geoid).
<Sep>	Numeric	Meter	-3.6	Geoidal separation (the difference between the earth

				ellipsoid surface and the mean-sea-level (geoid) surface defined by the reference datum used in the position solution).
<DiffAge>	-	-	-	Age of differential GPS data. Not supported.
<DiffStation>	-	-	-	Differential reference station ID. Not supported.
<NavStatus >	Character	-	V	Navigational status indicator. Not supported. Always “V” (Invalid).
<Checksum>	Hexadecimal	-	*0D	Checksum.
<CR><LF>	Character	-	-	Carriage return and line feed.

Example:

```
$GNGNS,053148.00,3149.279018,N,11706.919922,E,AANNNN,04,5.3,95.1,-3.6,,,V*0D
```

NOTE

1) <ModeInd> is a field type of variable length. The first character indicates the use of GPS satellites, the second character indicates the use of GLONASS satellites, the third character indicates the use of Galileo satellites, the fourth character indicates the use of BeiDou satellites, the fifth character indicates the use of QZSS satellites, and the sixth character indicates the use of NavIC (IRNSS) satellites.

2.2.4. GSV

GNSS Satellites in View. The GSV sentence provides the number of satellites (SV) in view, satellite ID numbers, elevation, azimuth, and SNR value, and contains maximum four satellites per transmission. Therefore, it may take several sentences to get complete information. The total number of sentences being transmitted and the sentence number are indicated in the first two fields of data fields.

Type:

Output.

Synopsis:

```
$<TalkerID>GSV,<TotalNumSen>,<SenNum>,<TotalNumSat>,<SatID>,<SatElev>,<SatAz>,<SatCN0>[,
…],<SignalID>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Example	Description
<TalkerID>	String, 2 characters	-	$GP	Talker identifier. See *Table 2: NMEA Talker ID.*
GSV	String, 3 characters	-	GSV	GNSS Satellites in View.
<TotalNumSen>	Numeric	-	3	Total number of sentences. Range: 1–9.
<SenNum>	Numeric	-	1	Sentence number. Range: 1–TotalNumSen.
<TotalNumSat>	Numeric	-	11	Total number of satellites in view.
Start of repeat block. Repeat times: 1–4.				
<SatID>	Numeric	-	01	Satellite ID. See *Table 43: GNSS Numbering*.
<SatElev>	Numeric	Degree	74	Satellite elevation. Range: 0–90.
<SatAz>	Numeric	Degree	142	Satellite azimuth, with true north as the reference plane. Range: 0–359.
<SatCN0>	Numeric	dB-Hz	46	Satellite SNR (C/N_0). Range: 00–99. Null when not tracking.
End of repeat block.				
<SignalID>	Numeric	-	1	GNSS signal ID. See *Table 43: GNSS Numbering.*
<Checksum>	Hexadecimal	-	*64	Checksum.
<CR><LF>	Character	-	-	Carriage return and line feed.

Example:

```
$GPGSV,3,1,11,01,74,142,46,07,57,216,43,08,39,045,43,14,34,316,44,1*64
$GPGSV,3,2,11,17,18,261,40,21,62,060,44,28,28,313,41,30,52,280,44,1*60
$GPGSV,3,3,11,01,,,39,08,,,35,30,,,38,8*60
$GLGSV,1,1,01,86,65,266,31,1*44
$GQGSV,2,1,04,02,59,131,43,03,73,061,43,1*6F
$GQGSV,2,2,04,02,,,32,03,,,30,8*6B
$GBGSV,2,1,06,40,63,004,38,27,63,268,41,37,72,183,41,1*4A
$GBGSV,2,2,06,40,,,36,27,,,36,37,,,37,5*75
$GAGSV,2,1,08,02,38,321,40,11,60,043,40,24,29,123,35,25,78,060,44,7*75
$GAGSV,2,2,08,02,,,34,11,,,34,24,,,27,25,,,36,1*7E
```

NOTE

GN cannot be used for GSV sentences. If satellites of multiple constellations are in view, use separate GSV sentences with the corresponding talker ID for each constellation.

2.2.5. GSA

GNSS DOP and Active Satellites. GNSS receiver operating mode, satellites used in the navigation solution reported by the GGA or GNS sentence, and DOP values.

Type:

Output.

Synopsis:

```
$<TalkerID>GSA,<Mode>,<FixMode>,<SatID>,…,<SatID>,<PDOP>,<HDOP>,<VDOP><SystemID>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Example	Description
<TalkerID>	String, 2 characters	-	$GN	Talker identifier. See *Table 2: NMEA Talker ID.*
GSA	String, 3 characters	-	GSA	GNSS DOP and Active Satellites.
<Mode>	Character	-	A	M = Manual, forced to operate in 2D or 3D mode. A = Automatic, allowed to automatically switch between 2D and 3D mode.
<FixMode>	Numeric	-	3	1 = Fix not available 2 = 2D 3 = 3D
Start of repeat block. Repeat times: 12.				
<SatID>	Numeric	-	01	ID numbers of satellites used in solution. See *Table 43: GNSS Numbering.*
End of repeat block.				
<PDOP>	Numeric	-	2.2	Position dilution of precision.
<HDOP>	Numeric	-	1.1	Horizontal dilution of precision. The maximum value is 99.0.
<VDOP>	Numeric	-	1.9	Vertical dilution of precision. The maximum value is 99.0.

<SystemID>	Numeric	-	1	GNSS system ID. See *Table 43: GNSS Numbering.*
<Checksum>	Hexadecimal	-	*31	Checksum.
<CR><LF>	Character	-	-	Carriage return and line feed.

Example:

```
$GNGSA,A,3,01,07,08,14,30,,,,,,,,2.2,1.1,1.9,1*31
$GNGSA,A,3,86,,,,,,,,,,,,2.2,1.1,1.9,2*34
$GNGSA,A,3,02,03,,,,,,,,,,,2.2,1.1,1.9,5*3C
$GNGSA,A,3,02,11,24,25,,,,,,,,,2.2,1.1,1.9,3*38
```

NOTE

If less than 12 satellites are used for navigation, the remaining <SatID> fields are left empty. If more than 12 satellites are used for navigation, only the IDs of the first 12 are output.

2.3. PGLOR Messages

These messages are defined by the chipset supplier.

2.3.1. FIX

GNSS time-to-first-fix (TTFF).

Type:

Output.

Synopsis:

```
$PGLOR,<SenVer>,FIX,<TTFF>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Example	Description
$PGLOR	String, 5 characters	-	$PGLOR	These messages are defined by the chipset supplier.
<SenVer>	Numeric	-	0	Sentence version.
FIX	-	-	FIX	-

<TTFF>	Numeric	Second	41.1	TTFF relative to when the request was received.
<Checksum>	Hexadecimal	-	*17	Checksum.
<CR><LF>	Character	-	-	Carriage return and line feed.

Example:

```
$PGLOR,0,FIX,41.1*17
```

NOTE

It will only output when it is fixed.

2.3.2. LSQ

LSQ is a kind of GNSS fix data, which contains time, LSQ position and fix-related data for a GNSS receiver.

Type:

Output.

Synopsis:

```
$PGLOR,<SenVer>,LSQ,<Time>,<Lat>,<N/S>,<Lon>,<E/W>,<HErr>,<HDOP>,<Alt>,<AltErr>,<VDOP>,
<HSpd>,<HSpdErr>,<VSpd>,<VSpdErr>,<TrkAng>,<TrkAngErr>,<NumSat>,<L1L5Bias>,<L5BiasSig>*<
Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Example	Description
$PGLOR	String, 5 characters	-	$PGLOR	These messages are defined by the chipset supplier.
<SenVer>	Numeric	-	1	Sentence version.
LSQ	-	-	LSQ	LSQ is a kind of GNSS fix data, which contains time, LSQ position and fix-related data for a GNSS receiver.
<Time>	hhmmss.ss	-	061215.00	UTC of position fix. hh: Hours (00–23) mm: Minutes (00–59) ss: Seconds (00–59) ss: Decimal fraction of seconds

<Lat>	Numeric	-	-	Latitude.
<N/S>	Character	-	-	N = North S = South
<Lon>	Numeric	-	-	Longitude.
<E/W>	Character	-	-	E = East W = West
<HErr>	Numeric	Meter	-	Horizontal error RMS.
<HDOP>	Numeric	-	-	Horizontal dilution of precision.
<Alt>	Numeric	Meter	-	Antenna altitude above/below WGS84 ellipsoid.
<AltErr>	Numeric	Meter	-	Altitude error RMS.
<VDOP>	Numeric	-	-	Vertical dilution of precision.
<HSpd>	Numeric	m/s	-	Horizontal speed.
<HSpdErr>	Numeric	m/s	-	Horizontal speed error RMS.
<VSpd>	Numeric	m/s	-	Vertical speed.
<VSpdErr>	Numeric	m/s	-	Vertical speed error RMS.
<TrkAng>	Numeric	Degrees	-	Track, azimuth clockwise from true North.
<TrkAngErr>	Numeric	Degrees	-	Track error RMS.
<NumSat>	Numeric	-	00	Number of satellites in use in LS (location service) fix, may be different from the number in view, and from number used in Kalman filter and shown in GNS/GGA.
<L1L5Bias>	Numeric	Meter	-	Bias estimation between L1 and L5 in the GNSS RF path.
<L5BiasSig>	Numeric	Meter^2	-	L5 bias estimation sigma.
<Checksum>	Hexadecimal	-	*3A	Checksum.
<CR><LF>	Character	-	-	Carriage return and line feed.

Example:

```
$PGLOR,1,LSQ,061215.00,,,,,,,,,,,,,,00,,*3A
```

2.3.3. PWR

Power consumption report.

Type:

Output.

Synopsis:

```
$PGLOR,<SenVer>,PWR,mA,<Current>,RFTm,<RFTm>,OscTm,<OscTm>,MeasTm,<MeasTm>,UTC,<UTC>,GNSSmA,<GNSSmA>,CPUTm,<CPUTm>,COPTm,<COPTm>,SrchTm,<SrchTm>,TrkTm,<TrkTm>,RpcTm,<RpcTm>,McuTotalTm,<McuTotalTm>,McuSleepTm,<McuSleepTm>,McuIdleTm,<McuIdleTm>,Mcu26Tm,<Mcu26Tm>,Mcu52Tm,<Mcu52Tm>,McuTurboTm,<McuTurboTm>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Example	Description
$PGLOR	String, 5 characters	-	$PGLOR	These messages are defined by the chipset supplier.
<SenVer>	Numeric	-	5	Sentence version.
PWR	-	-	PWR	Power consumption report.
mA	-	-	mA	-
<Current>	Numeric	mA	42.3	Average current during the last measurement.
RFTm	-	-	RFTm	-
<RFTm>	Numeric	Millisecond	1000	RF working time.
OscTm	-	-	OscTm	-
<OscTm>	Numeric	Millisecond	1000	Oscillator working time.
MeasTm	-	-	MeasTm	-
<MeasTm>	Numeric	Millisecond	1000	Measurement duration.
UTC	-	-	UTC	-
<UTC>	hhmmss.ss	-	062504.00	UTC time of position fix: hh: Hours (00–23) mm: Minutes (00–59) ss: Seconds (00–59) ss: Decimal fraction of

				seconds
GNSSmA	-	-	GNSSmA	-
<GNSSmA>	Numeric	mA	37.6	Average current attributed to the GNSS core.
CPUTm	-	-	CPUTm	-
<CPUTm>	Numeric	Millisecond	538	CPU working time.
COPTm	-	-	COPTm	-
<COPTm>	Numeric	Millisecond	130	Coprocessor working time.
SrchTm	-	-	SrchTm	-
<SrchTm>	Numeric	Millisecond	680	Searching time.
TrkTm	-	-	TrkTm	-
<TrkTm>	Numeric	Millisecond	773	Tracking time.
RpcTm	-	-	RpcTm	-
<RpcTm>	Numeric	Millisecond	212	Time spent processing RPCs.
McuTotalTm	-	-	McuTotalTm	-
<McuTotalTm>	Numeric	Millisecond	1002	Total profiling time of MCU.
McuSleepTm	-	-	McuSleepTm	-
<McuSleepTm>	Numeric	Millisecond	0	Time of MCU in sleep state.
McuIdleTm	-	-	McuIdleTm	-
<McuIdleTm>	Numeric	Millisecond	544	Time of MCU in idle state.
Mcu26Tm	-	-	Mcu26Tm	-
<Mcu26Tm>	Numeric	Millisecond	3	MCU time (The CPU is in 26 MHz mode.)
Mcu52Tm	-	-	Mcu52Tm	-
<Mcu52Tm>	Numeric	Millisecond	106	MCU time (The CPU is in 52 MHz mode.)
McuTurboTm	-	-	McuTurboTm	-
<McuTurboTm>	Numeric	Millisecond	350	MCU time (The CPU is in turbo mode.)
<Checksum>	Hexadecimal	-	*7D	Checksum.

<CR><LF>	Character	-	-	Carriage return and line feed.

Example:

```
$PGLOR,5,PWR,mA,42.3,RFTm,1000,OscTm,1000,MeasTm,1000,UTC,062504.00,GNSSmA,37.6,CPU
Tm,538,COPTm,130,SrchTm,680,TrkTm,773,RpcTm,212,McuTotalTm,1002,McuSleepTm,0,McuIdleTm,
544,Mcu26Tm,3,Mcu52Tm,106,McuTurboTm,350*7D
```

2.3.4. SAT

GNSS satellite information.

Type:

Output.

Synopsis:

```
$PGLOR,<SenVer>,SAT,<TolMsg>,<MsgNum>,<SatID>,<CN0>,<SatInfo>,<...>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Example	Description
$PGLOR	String, 5 characters	-	$PGLOR	These messages are defined by the chipset supplier.
<SenVer>	Numeric	-	2	Sentence version.
SAT	-	-	SAT	-
<TolMsg>	Numeric	-	4	Total number of messages. Range: 1–6.
<MsgNum>	Numeric	-	1	Message number. Range: 1– TolMsg.
Start of repeated block (Maximum repeat times = 6).				
<SatID>	Character + Numeric	-	G16	This is a concatenation of two items: the GNSS system ID and the GNSS satellite ID. GNSS system ID can be G, R, Q, S, B, E, or N. G = GPS R = GLONASS Q = QZSS S = SBAS B = BeiDou

				E = Galileo N = NavIC GNSS satellite ID: 01–64.
<CN0>	Numeric	dB-Hz	35	Carrier-to-noise.
<SatInfo>	Hexadecimal	-	13	Satellite information in hex format. This will be two, three, or four hexadecimal characters with the following bit definitions: Bit 0: L1 Pr measurement valid from measurement engine. Bit 1: L1 Rr measurement valid from measurement engine. Bit 2: L1 Pr measurement used in the position computation. Bit 3: L1 Rr measurement used in the position computation. Bit 4 and 5: Ephemeris source. Bit 6: DGNSS used in position computation. Bit 7: L5 Pr measurement valid from measurement engine. Bit 8: L5 Rr measurement valid from measurement engine. Bit 9: L5 Pr measurement used in the position computation. Bit 10: L5 Rr measurement used in the position computation. Bit 11–31: Reserved. Pr = Pseudorange. Rr = Range rate.
End of repeated block.				
<Checksum>	Hexadecimal	-	*06	Checksum.
<CR><LF>	Character	-	-	Carriage return and line feed.

Example:

```
$PGLOR,2,SAT,4,1,G01,43,1F,G04,42,13,G08,19,13,G09,40,09F,G11,32,13,G16,35,13*06
$PGLOR,2,SAT,4,2,G17,38,13,G22,42,13,G27,28,13,R13,36,1F,R23,20,11,R17,45,1F*24
$PGLOR,2,SAT,4,3,Q01,41,1F,Q02,32,1F,Q03,36,13,B06,38,13,B08,36,13,B09,38,13*25
$PGLOR,2,SAT,4,4,B11,39,13,B13,40,13,B16,38,13,B24,32,13,B26,43,13,B34,24,13*37
```

2.3.5. STA

GNSS latitude/longitude status.

Type:

Output.

Synopsis:

```
$PGLOR,<SenVer>,STA,<UTC>,<RTCInitErr>,<RTCUncer>,<OscOffset>,<OscUncer>,<PosUncer>,<VelTrkQual>,P,<PwrSaveMode>,L,<HULALoc>,C,<HULAPosCon>,S,<HULAPosSrc>,<Dist>,<TimSrc>,R,<HULASrc>,<AidStatus>,<NumSatEph>,<ElapTm>,LC,,,DR,0,*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Example	Description
$PGLOR	String, 5 characters	-	$PGLOR	These messages are defined by the chipset supplier.
<SenVer>	Numeric	-	10	Sentence version.
STA	-	-	STA	-
<UTC>	hhmmss.ss	-	070123.00	UTC of position fix. hh: Hours (00–23) mm: Minutes (00–59) ss: Seconds (00–59) ss: Decimal fraction of seconds
<RTCInitErr>	Numeric	Second	-0.002	RTC initial error.
<RTCUncer>	Numeric	Second	0.000	RTC uncertainty.
<OscOffset>	Numeric	PPB	961	Oscillator offset.
<OscUncer>	Numeric	PPB	0	Oscillator uncertainty.
<PosUncer>	Numeric	Meter	2	Position uncertainty.
<VelTrkQual>	Numeric	-	0	Internal velocity and track quality (This field is independent of RMC speed and track, and does not indicate speed or track validity.): 0: Poor velocity, poor track. 1: Good velocity, poor track. 2: Poor velocity, good track. 3: Good velocity, good track.
P	-	-	P	-

<PwrSaveMode>	Character	-	D	Power-saving mode status indications. D: Disabled, always in full-power mode. F: Enabled, now in full-power mode. S: Enabled, now in power-saving mode. H: Host offload mode.
L	-	-	L	-
<HULALoc>	Numeric	-	0	HULA request for location input values. 0: Location input not needed. 1: Location input requested.
C	-	-	C	-
<HULAPosCon>	Numeric	-	0	HULA position confidence values. 0: Unknown. 1: Low. 2: Medium. 3: High.
S	-	-	S	-
<HULAPosSrc>	Numeric	-	00000000	Not supported.
<Dist>	Numeric	Meter	0	Accumulated distance since start.
<TimSrc>	Numeric	-	0	Time Source. 0: Time is invalid. 1: Time is restored after standby. 2: Time is derived from assistance. 3: Time is from position computation (not supported yet). 4: Time is from TOW and WN decoding from one satellite. 5: Time is from TOW and WN decoding from more than one satellite.
R	-	-	R	-
<HULASrc>	Numeric	-	00000000	Not supported.
<AidStatus>	Character	-	tpef	Aiding status: [tT][pP][eE][fF] Time available (T), not available (t). Position available (P), not available (p). Ephemeris available (E), not available for 90% of all in view satellites (e). Frequency available (F), not available

				(f).
<NumSatEph>	Numeric	-	0	Number of satellites with valid ephemeris.
<ElapTm>	Numeric	ms	4324807	Elapsed time (LMS).
LC,,,DR,0,	-	-	LC,,,DR,0,	-
<Checksum>	Hexadecimal	-	-	Checksum.
<CR><LF>	Character	-	-	Carriage return and line feed.

Example:

```
$PGLOR,10,STA,070123.00,-0.002,0.000,961,0,2,0,P,D,L,0,C,0,S,00000000,0,0,R,00000000,tpef,0,432
4807,LC,,,DR,0,*31
```

2.3.6. SPD

Speed status.

Type:

Output.

Synopsis:

```
$PGLOR,<SenVer>,SPD,<ReqID>,<Date>,<Time>,<SpdValid>,<Spd>,<StepLenValid>,<StepLen>,<Cad
Valid>,<Cad>,<DistValid>,<DistA>,<DistB>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Example	Description
$PGLOR	String, 5 characters	-	$PGLOR	These messages are defined by the chipset supplier.
<SenVer>	Numeric	-	0	Sentence version.
SPD	-	-	SPD	-
<ReqID>	Numeric	-	0	Request ID.
<Date>	ddmmyy	-	100420	Date. dd: Day of month mm: Month yy: Year
<Time>	hhmmss.ss	-	074045.00	UTC of position fix. hh: Hours (00–23)

				mm: Minutes (00–59) ss: Seconds (00–59) ss: Decimal fraction of seconds
<SpdValid>	Character	-	s	‘S’ if speed is valid; otherwise ‘s’.
<Spd>	Numeric	m/s	0.0	Speed.
<StepLenValid>	Character	-	l	‘L’ if step length is valid, otherwise ‘l’.
<StepLen>	Numeric	Meter	0.00	Step length in meters, if valid.
<CadValid>	Character	-	c	‘C’ if cadence is valid, otherwise ‘c’.
<Cad>	Numeric	Hz	0.0	Cadence in Hz, if valid.
<DistValid>	Character	-	D	‘D’ if distance is valid, otherwise ‘d’.
<DistA>	Numeric	km	0	Kilometer part of distance (A), if valid.
<DistB>	Numeric	Meter	768.7	Distance under kilometer part (B). Total distance = 1000 * A + B(meter).
<Checksum>	Hexadecimal	-	*1C	Checksum.
<CR><LF>	Character	-	-	Carriage return and line feed.

Example:

```
$PGLOR,0,SPD,0,100420,074045.00,s,  0.0,l,0.00,c,  0.0,D,  0,768.7*1C
```

3 Bream Protocol

This chapter introduces the Broadcom Bream proprietary protocol which is supported by LC29D.

3.1. Structure of Bream Protocol Messages

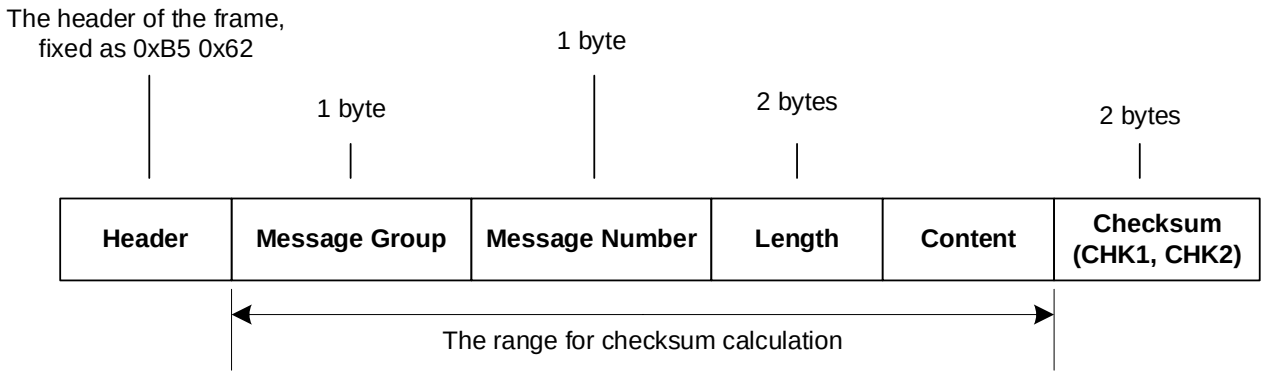

Figure 2: Structure of Bream protocol message

Table 3: Structure of Bream Protocol Messages

Field	Description
Header	The header of the Bream protocol frame that consists of 2 bytes: 0xB5, 0x62.
Message Group	1-byte message group.
Message Number	1-byte message number.
Length	The length of the **Content** field. Unit: byte. It does not include the Header, Message Group, Message Number, Length or Checksum fields. The length format is a 16-bit unsigned integer with a little-endian.
Content	The payload of the message, with a variable number of bytes.
Checksum	2-byte checksum (CHK1 and CHK2), holds a 16-bit checksum whose calculation is similar to an 8-bit Fletcher algorithm.

The sample code for checksum:

```
//Buffer is the data array of which the checksum needs to be calculated.
uint8_t CHK1 = 0;
uint8_t CHK2 = 0;
for(i = 0; i < length; i++)
{
CHK1 = CHK1 + Buffer[i];
CHK2 = CHK2 + CHK1;
}
```

3.2. ACK and NACK Messages (0x05)

3.2.1. BRM-ACK-ACK (0x05 0x01)

Message acknowledged. Output upon processing an input message.

Type:

Output.

Structure:

Header	Message Group	Message Number	Length (Bytes)	Content	Checksum
0xB5 0x62	0x05	0x01	2	See *Table 4: BRM-ACK-ACK Message Content.*	CHK1 CHK2

Table 4: BRM-ACK-ACK Message Content

Byte Offset	C99	Scaling	Name	Unit	Description
0	uint8_t	-	GrpNum	-	Group number of the acknowledged message.
1	uint8_t	-	MsgNum	-	Message number of the acknowledged message.

3.2.2. BRM-ACK-NAK (0x05 0x00)

Message not acknowledged. Output upon processing an input message.

Type:

Output.

Structure:

Header	Message Group	Message Number	Length (Bytes)	Content	Checksum
0xB5 0x62	0x05	0x00	2	See *Table 5: BRM-ACK-NAK Message Content.*	CHK1 CHK2

Table 5: BRM-ACK-NAK Message Content

Byte Offset	C99	Scaling	Name	Unit	Description
0	uint8_t	-	GrpNum	-	Group number of the unacknowledged message.
1	uint8_t	-	MsgNum	-	Message number of the unacknowledged message.

3.3. ASIC (GNSS Device) Manager Messages (0x02)

3.3.1. BRM-ASC-SLEEP (0x02 0x41)

Put the GNSS device in deep sleep mode.

Type:

Command.

Structure

Header	Message Group	Message Number	Length (Bytes)	Content	Checksum
0xB5 0x62	0x02	0x41	16	See *Table 6: BRM-ASC-SLEEP Message Content*.	CHK1 CHK2

Table 6: BRM-ASC-SLEEP Message Content

Byte Offset	C99	Scaling	Name	Unit	Description
0	uint8_t	-	Version	-	Message version (0x00).
1	uint8_t[3]	-	Reserved	-	Reserved.
4	uint32_t	-	Duration	ms	Duration of the requested task, set to zero for infinite duration. The maximum supported time is 12 days.
8	uint32_t	-	Flags	-	Task flags. See *Table 7: Flags Flag Bits.*
12	uint32_t	-	WakeupSources		Configure pins to wake up the GNSS device. The GNSS device wakes up if there is either a falling or a rising edge on one of the configured pins. See *Table 8: WakeupSources Flag Bits*.

Table 7: *Flags* Flag Bits

Name	Flag Bits	Description
Sleep	1	1: Put the GNSS device in deep sleep mode for a time period defined by *Duration*.

Table 8: *WakeupSources* Flag Bits

Name	Flag Bits	Description
Uartrx	3	1: Wake up if there is an edge on the UART RX pin.
Spics	7	1: Wake up if there is an edge on the SPI CS pin.

3.3.2. BRM-ASC-SUBFRAME (0x02 0x13)

A navigation data subframe. This message reports a complete subframe of broadcast navigation data decoded from a single signal. The number of data words reported in each message depends on the signal type (which is determined from the GNSS_ID field). The supported signals are GPS L1 C/A, QZSS L1 C/A, GLONASS L1 OF, Galileo E1 B, BeiDou B1I D1, and NavIC L5A. Each **BRM-ASC-SUBFRAME** message contains a number of 32-bit words, as indicated by the *NumWords* field.

Type:

Output.

Structure

Header	Message Group	Message Number	Length (Bytes)	Content	Checksum
0xB5 0x62	0x02	0x13	8 + 4 * NumWords	See *Table 9: BRM-ASC-SUBFRAME Message Content.*	CHK1 CHK2

Table 9: BRM-ASC-SUBFRAME Message Content

Byte Offset	C99	Scaling	Name	Unit	Description
0	uint8_t	-	GNSS_ID	-	GNSS identifier. See *Table 43: GNSS Numbering.*
1	uint8_t	-	SvID	-	Satellite identifier. See *Table 43: GNSS Numbering*
2	uint8_t	-	Reserved1	-	Reserved.
3	uint8_t	-	FreqID	-	Only used for GLONASS. The value is the frequency slot plus 7. Range: 0–13.
4	uint8_t	-	NumWords	-	The number of data words contained in this message.
5	uint8_t	-	Reserved2	-	Reserved.
6	uint8_t	-	Version	-	Version. 0x01 for this version.
7	uint8_t	-	Reserved3	-	Reserved.
Start of repeated block (NumSvs times)					
8 + 4 * N	uint32_t	-	Dwrd	-	*NumWords* data words.
End of repeated block					

NOTE

Only LC29D (A) and LC29D (B) support this message.

3.3.2.1.GPS/QZSS/NavIC Subframe

The structure of GPS/QZSS/NavIC subframe words in this message are matched with subframe words description in the each ICD. Each subframe comprises 10 data words, which are reported in the same order they are received.

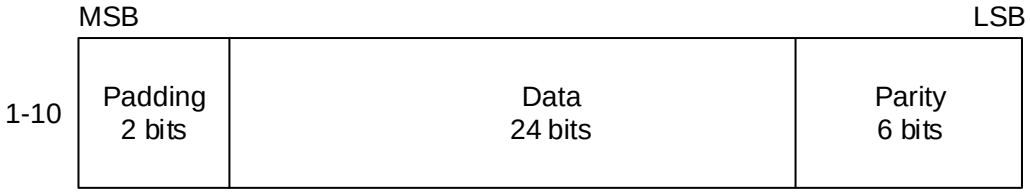

Figure 3: Structure of GPS/QZSS/NavIC Subframe Word

NOTE

The 2 most significant bits in each word are padding bits and should be ignored.

3.3.2.2.BeiDou B1I D1 Subframe

The structure of BeiDou B1I D1 subframe words in this message are matched with subframe words description in the BeiDou ICD. Each subframe comprises 10 data words, which are reported in the same order they are received.

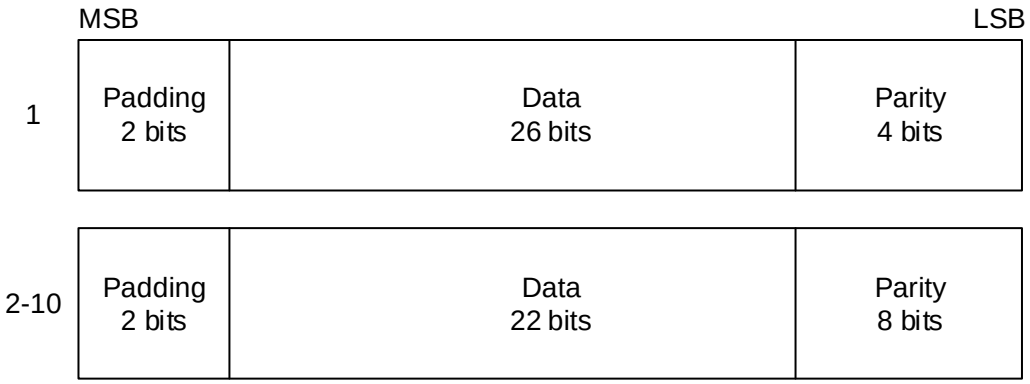

Figure 4: Structure of BeiDou B1I D1 Subframe Word

NOTE

The 2 most significant bits in each word are padding bits and should be ignored.

3.3.2.3.GLONASS L1 OF Subframe

There is a total of four 32-bit data words in each string. The first three words include 85 data bits and 11 padding bits in the least significant bits.

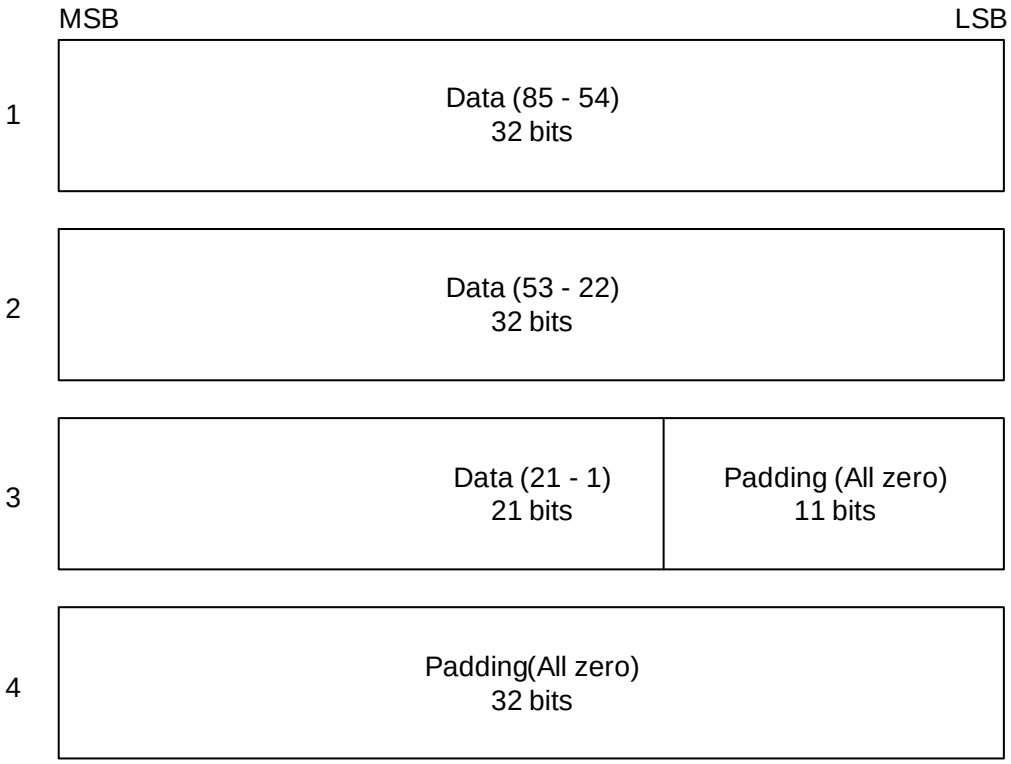

Figure 5: Structure of GLONASS L1 OF Subframe Word

NOTE

1. The bits 0–10 in the 3rd word are padding bits and should be ignored.
2. The 4th word are all zero and should be ignored.

3.3.2.4.Galileo E1 B Subframe

For Galileo E1 B signals, the 9 data words contain a pair of I/NAV pages as described in the Galileo ICD.

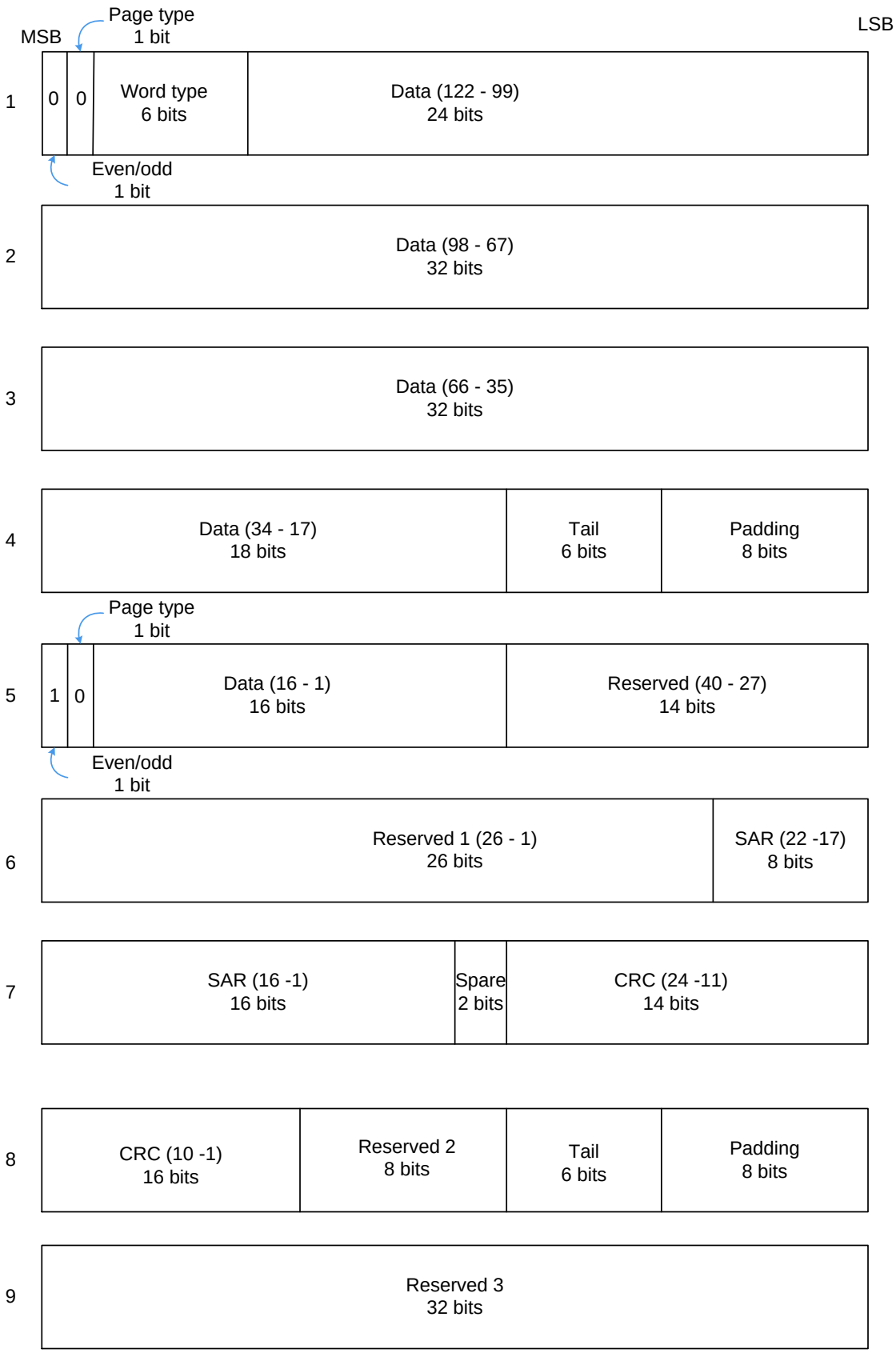

Figure 6: Structure of Galileo E1 B Subframe Word

NOTE

1. The bits 0–7 in 4th and 8th word are padding bits and should be ignored.
2. The 9th word should be ignored.

3.3.3. BRM-ASC-MEAS (0x02 0x15)

Multi-GNSS raw measurement data. This message contains pseudorange, doppler shift, carrier phase, phase lock, and signal quality information for GNSS satellites after signals have been synchronized. The maximum message rate is limited to 1 Hz.

Type:

Output.

Structure

Header	Message Group	Message Number	Length (Bytes)	Content	Checksum
0xB5 0x62	0x02	0x15	16 + 32 * NumMeas	See *Table 10: BRM-ASC-MEAS Message Content*.	CHK1 CHK2

Table 10: BRM-ASC-MEAS Message Content

Byte Offset	C99	Scaling	Name	Unit	Description
0	double	-	RcvTOW	Second	Measurement time of week in receiver local time approximately aligned to the GPS time system.
8	uint16_t	-	Week	Week	GPS week number.
10	int8_t	-	LeapS	Second	GPS leap second (GPS-UTC). This field represents the receiver's best knowledge of the leap second offsets. A flag is given in *RecStat* to indicate if the leap seconds are known.
11	uint8_t	-	NumMeas	-	Number of measurements. See *Table 11: MEAS Content Blocks – Repeated NumMeas Times.*
12	uint8_t	-	RecStat	-	Receiver tracking status bit field. See *Table 12: RecStat Bit Field Definition*
13	uint8_t[3]	-	Reserved	-	Reserved.

Table 11: MEAS Content Blocks – Repeated *NumMeas* Times

Byte Offset	C99	Scaling	Name	Unit	Description
16 + 32 * N	double	-	PrMes	Meter	Pseudorange measurement. GLONASS inter-frequency channel delays are compensated with an internal calibration table.
24 + 32 * N	double	-	CpMes	Cycle	Carrier phase measurement. The carrier phase initial ambiguity is initialized using an approximate value to make the magnitude of the phase close to the pseudorange measurement.
32 + 32 * N	float	-	DpMes	Hz	Measured Doppler shift (positive sign for approaching satellites).
36 + 32 * N	uint8_t	-	GNSS_ID	-	GNSS identifier. See *Table 43: GNSS Numbering.*
37 + 32 * N	uint8_t	-	SvID	-	Satellite identifier. See *Table 43: GNSS Numbering*
38 + 32 * N	uint8_t	-	SigID	-	Signal identifier. See *Table 13: SigID Signal Identifiers.*
39 + 32 * N	uint8_t	-	FreqID	-	Only used for GLONASS. The value is the frequency slot plus 7. Range: 0–13.
40 + 32 * N	uint16_t	-	LockTime	ms	Carrier phase lock-time counter (maximum 64,500 ms).
42 + 32 * N	uint8_t	-	CN0	dB-Hz	Carrier-to-noise density ratio (signal strength).
43 + 32 * N	uint8_t	0.01 * 2^n	PrStdev	Meter	Estimated pseudorange measurement standard deviation. See *Table 14: PrStdev Bit Field Definition.*
44 + 32 * N	uint8_t	0.004	CpStdev	Cycle	Estimated carrier phase measurement standard deviation. (A raw value of 0x0F indicates the value is invalid.) See *Table 15: CpStdev Bit Field Definition.*
45 + 32 * N	uint8_t	0.002 * 2^n	DoStDev	Hz	Estimated Doppler-shift measurement standard deviation. See *Table 16: DoStdev Bit Field Definition.*
46 + 32 * N	uint8_t	-	TrkStat	-	Tracking status bit field. See *Table 17: TrkStat Bit Field Definition.*
47 + 32 * N	uint8_t	-	Frac_CN0	-	Bits 0–2: Fractional part of CN0 (1/8 dB-Hz resolution).

	Bits 3–7: Reserved.

Table 12: *RecStat* Bit Field Definition

Name	Bit	Description
ClkReset	0	Clock reset applied. Typically, the receiver clock is changed in increments of integer milliseconds.
LeapSec	1	Leap seconds that have been determined.

Table 13: *SigID* Signal Identifiers

SigID	GPS	Galileo	BeiDou	QZSS	GLONASS	NavIC
0	L1 C/A	E1	B1I D1	L1 C/A	L1	L5
1	-	-	B1I D2	-	-	-
4	-	E5a	-	-	-	-
7	L5-Q	-	B2a	-	-	-
9	-	-	-	L5-Q	-	-

Table 14: *PrStdev* Bit Field Definition

Name	Bit	Description
PrStd	0–3	Estimated pseudorange standard deviation.

Table 15: *CpStdev* Bit Field Definition

Name	Bit	Description
CpStd	0–3	Estimated carrier phase standard deviation.

Table 16: *DoStdev* Bit Field Definition

Name	Bit	Description
DoStd	0-3	Estimated doppler-shift standard deviation.

Table 17: *TrkStat* Bit Field Definition

Name	Bit	Description
PrValid	0	The validity of Pseudorange.
CpValid	1	The validity of carrier phase.
HalfCyc	2	The validity of half cycle.
SubHalfCyc	3	Half cycle subtracted from phase.

NOTE

Only LC29D (A) and LC29D (B) support this message.

3.4. PVT Results Messages (0x01)

3.4.1. BRM-PVT-ACC_DIST (0x01 0x09)

This message outputs the travel distance since the last reset (see BRM-PVT-RESET_ACC_DIST) together with an associated estimated accuracy and the total accumulated ground distance. The polled data can only be reset by a cold start of the GNSS device.

Type:

Output.

Structure

Header	Message Group	Message Number	Length (Bytes)	Content	Checksum
0xB5 0x62	0x01	0x09	20	See *Table 18: BRM-PVT-ACC_DIST Message Content.*	CHK1 CHK2

Table 18: BRM-PVT-ACC_DIST Message Content

Byte Offset	C99	Scaling	Name	Unit	Description
0	uint8_t	-	Version	-	Message version (0x00).
1	uint8_t[3]	-	Reserved	-	Reserved
4	uint32_t	-	TOW	ms	GPS time of week of the navigation epoch.
8	uint32_t	-	Distance	Meter	Ground distance since last reset.
12	uint32_t	-	TotalDistance	Meter	Total cumulative ground distance.
16	uint32_t	-	DistanceStd	Meter	Ground distance accuracy (1-sigma). (Not implemented)

3.4.2. BRM-PVT-RESET_ACC_DIST (0x01 0x10)

This message resets the accumulated distance computed by the odometer (see BRM-PVT-ACC_DIST). BRM-ACK-ACK or BRM-ACK-NAK are returned to indicate success or failure.

Type:

Command.

Structure

Header	Message Group	Message Number	Length (Bytes)	Content	Checksum
0xB5 0x62	0x01	0x10	0	None	CHK1 CHK2

3.4.3. BRM-PVT-DOP (0x01 0x04)

DOP values are dimensionless. All DOP values are scaled by a factor of 100. If a DOP value transmits a value of 156, then the DOP value is 1.56.

Type:

Output.

Structure

Header	Message Group	Message Number	Length (Bytes)	Content	Checksum
0xB5 0x62	0x01	0x04	18	See *Table 19: BRM-PVT-DOP Message Content.*	CHK1 CHK2

Table 19: BRM-PVT-DOP Message Content

Byte Offset	C99	Scaling	Name	Unit	Description
0	uint32_t	-	TOW	ms	GPS time of week of the navigation epoch.
4	uint16_t	0.01	GDOP	-	Geometric DOP. (Not supported)
6	uint16_t	0.01	PDOP	-	Position DOP.
8	uint16_t	0.01	TDOP	-	Time DOP. (Not supported)
10	uint16_t	0.01	VDOP	-	Vertical DOP.
12	uint16_t	0.01	HDOP	-	Horizontal DOP.
14	uint16_t	0.01	NDOP	-	Northing DOP. (Not supported)
16	uint16_t	0.01	EDOP	-	Easting DOP. (Not supported)

3.4.4. BRM-PVT-EOE (0x01 0x61)

This message is intended to be used as a marker to collect all PVT messages of an epoch. It is output after all enabled PVT group messages and after all enabled NMEA messages.

Type:

Output.

Structure

Header	Message Group	Message Number	Length (Bytes)	Content	Checksum
0xB5 0x62	0x01	0x61	4	See *Table 20: BRM-PVT-EOE Message Content.*	CHK1 CHK2

Table 20: BRM-PVT-EOE Message Content

Byte Offset	C99	Scaling	Name	Unit	Description
0	uint32_t	-	TOW	ms	GPS time of week of the navigation epoch.

3.4.5. BRM-PVT-PVT (0x01 0x07)

Navigation position-velocity-time (PVT) solution.

Type:

Output.

Structure

Header	Message Group	Message Number	Length (Bytes)	Content	Checksum
0xB5 0x62	0x01	0x07	92	See *Table 21: BRM-PVT-PVT Message Content.*	CHK1 CHK2

Table 21: BRM-PVT-PVT Message Content

Byte Offset	C99	Scaling	Name	Unit	Description
0	uint32_t	-	TOW	ms	GPS time of week of the navigation epoch.
4	uint16_t	-	Year	Year	Year (UTC).
6	uint8_t	-	Month	Month	Month. Range: 1–12 (UTC).
7	uint8_t	-	Day	Day	Day of the month. Range: 1–31 (UTC).
8	uint8_t	-	Hour	Hour	Hour of the day. Range: 0–23 (UTC).
9	uint8_t	-	Min	Minute	Minute of the hour. Range: 0–59 (UTC).
10	uint8_t	-	Sec	Second	Second of the minute. Range: 0–59 (UTC).
11	uint8_t	-	Valid	-	Validity flags. See *Table 22: Valid Flag Bits.*
12	uint32_t	-	TAcc	ns	Time accuracy estimate (UTC).
16	int32_t	-	Nano	ns	Fraction of second. Range: –1e9–1e9 (UTC).

20	uint8_t	-	FixType	-	GNSS fix type. 0: No fix. 1: Dead reckoning only. 2: Two-dimensional fix. 3: Three-dimensional fix. 4: GNSS plus dead reckoning combined. 5: Time-only fix.
21	uint8_t	-	Flags	-	Fix status flags. See *Table 23: Flags Flag Bits.*
22	uint8_t	-	Flags2	-	Additional flags. See *Table 24: Flags2 Flag Bits.*
23	uint8_t	-	NumSV	-	Number of satellites used in the navigation solution.
24	int32_t	1e-7	Lon	Degree	longitude
28	int32_t	1e-7	Lat	Degree	Latitude
32	int32_t	-	Height	mm	Height above ellipsoid.
36	int32_t	-	HMSL	mm	Height above mean sea level.
40	uint32_t	-	HAcc	mm	Horizontal accuracy estimate.
44	uint32_t	-	VAcc	mm	Reserved. Vertical accuracy estimate.
48	int32_t	-	VelN	mm/s	NED north velocity.
52	int32_t	-	VelE	mm/s	NED east velocity.
56	int32_t	-	VelD	mm/s	NED down velocity.
60	int32_t	-	GSpeed	mm/s	Ground speed (two-dimensional).
64	int32_t	1e-5	HeadMot	Degree	Heading of motion (two-dimensional).
68	uint32_t	-	SAcc	mm/s	Reserved. Speed accuracy estimate.
72	uint32_t	1e-5	HeadAcc	Degree	Reserved. Heading accuracy estimate (both motion and vehicle).
76	uint16_t	0.01	PDOP	-	Position DOP.
78	uint8_t[6]	-	Reserved	-	Reserved.
84	int32_t	1e-5	HeadVeh	Degree	Heading of vehicle (two-dimensional).
88	int16_t	1e-2	MagDec	Degree	Magnetic declination.
90	uint16_t	1e-2	MagAcc	Degree	Magnetic declination accuracy.

Table 22: *Valid* Flag Bits

Name	Flag Bits	Description
ValidDate	0	1: Valid UTC date
ValidTime	1	1: Valid UTC time of day.
FullyResolved	2	1: UTC time of day that has been fully resolved (no second uncertainty).

Table 23: *Flags* Flag Bits

Name	Flag Bits	Description
GNSS_FixOK	0	1: Valid fix (that is, within DOP and accuracy masks).

Table 24: *Flags2* Flag Bits

Name	Flag Bits	Description
Reserved	0–4	1: Valid fix (that is, within DOP and accuracy masks).
ConfirmedAvail	5	1: Information about UTC date and time-of-day validity confirmation is available.
ConfirmedDate	6	1: UTC date validity that has been confirmed.
ConfirmedTime	7	1: UTC time of day that has been confirmed.

3.4.6. BRM-PVT-SAT (0x01 0x35)

This message displays information about SVs that are either known to be visible or currently tracked by the GNSS device. All signal-related information corresponds to the subset of signals specified in the signal identifiers.

Type:

Output.

Structure

Header	Message Group	Message Number	Length (Bytes)	Content	Checksum
0xB5 0x62	0x01	0x35	8 + 12 * NumSvs	See *Table 21: BRM-PVT-PVT Message Content.*	CHK1 CHK2

Table 25: BRM-PVT-SAT Message Content

Byte Offset	C99	Scaling	Name	Unit	Description
0	uint32_t	-	TOW	ms	GPS time of week of the navigation epoch.
4	uint8_t	-	Version	-	Message version (0x01).
5	uint8_t	-	NumSvs	-	Number of SVs.
6	uint8_t[2]	-	Reserved1	-	Reserved.
Start of repeated block (NumSvs times)					
8 + 12 * N	uint8_t	-	GNSS_ID	-	GNSS identifier. See *Table 43: GNSS Numbering.*
9 + 12 * N	uint8_t	-	SvId	-	Satellite identifier. See *Table 43: GNSS Numbering.*
10 + 12 * N	uint8_t	-	CN0	dB-Hz	Carrier-to-noise ratio (signal strength).
11 + 12 * N	int8_t	-	Elev	Degrees	Elevation (range: -90 to +90), unknown if out of range.
12 + 12 * N	int16_t	-	Azim	Degrees	Azimuth (range 0–360), unknown if elevation is out of range.
14 + 12 * N	int16_t	0.1	PrRes	Meter	Pseudorange residual.
16 + 12 * N	uint32_t	-	Flags	-	Bit mask. See *Table 26: Flags Flag Bits.*
End of repeated block					

Table 26: *Flags* Flag Bits

Name	Flag Bits	Description
QualityInd	0–2	Signal quality indicator: 0: No signal. 1: Searching signal. 2: Signal acquired.

		3: Signal detected but unusable. 4: Code locked and time synchronized. 5–7: Code and carrier locked and time synchronized.
SvUsed	3	1: Signal in the subset specified in signal identifiers is currently being used for PVT.
Health	4–5	Signal health flag. 0: Unknown. 1: Healthy. 2: Unhealthy.
Reserved	6–7	Reserved.
OrbitSource	8–10	Orbit source. 0: No orbit information is available for this SV. 1: Ephemeris is used. 2: Almanac is used. 3: LTO orbit is used. 4:. Reserved 5–7: Other orbit information is used.
EphAvail	11	1: Ephemeris is available for this SV.
AlmAvail	12	1: Almanac is available for this SV.
LTOAvail	13	1: LTO data is available for this SV.
Reserved	14	Reserved
Reserved	15–26	Reserved.
Frac_CN0	27–29	Fractional part of the carrier-to-noise ratio (CN0). 0.125 dB-Hz resolution.
Carrier_band	30–31	Carrier band used: 0: L1. 2: L5.

3.5. Setup Messages (0x06)

3.5.1. BRM-STP-CONFIG (0x06 0x09)

Clear, save, and load setups.

Type:

Command.

Structure

Header	Message Group	Message Number	Length (Bytes)	Content	Checksum
0xB5 0x62	0x06	0x09	13	See *Table 27: BRM-STP-CONFIG Message Content.*	CHK1 CHK2

Table 27: BRM-STP-CONFIG Message Content

Byte Offset	C99	Scaling	Name	Unit	Description
0	uint32_t	-	ClearMask	-	Mask with setup subsections to clear (that is, load default setups to permanent setups in nonvolatile memory). See *Table 28: ClearMask (SaveMask, LoadMask) Flag Bits.*
4	uint32_t	-	SaveMask	-	Mask with setup subsections to save (that is, to save current setups to nonvolatile memory). See *Table 28: ClearMask (SaveMask, LoadMask) Flag Bits.*
8	uint32_t	-	LoadMask	-	Mask with setup subsections to load (that is, load permanent setups from nonvolatile memory to current setups). See *Table 28: ClearMask (SaveMask, LoadMask) Flag Bits.*
12	uint8_t	-	Reserved	-	Reserved.

Table 28: *ClearMask (SaveMask, LoadMask) Flag Bits*

Name	Flag Bits	Description
IoPort	0	Communications port settings. Modifying this subsection results in an I/O system reset. Because of this, undefined data may be output for a short period of time after receiving the message.
MsgConf	1	Message setup.
InfMsg	2	WNG message setup.
PVTConf	3	PVT setup.
ASCConf	4	ASIC (GNSS device) manager setup.
Reserved	8	Reserved.
Reserved	9	Reserved.

Reserved	10	Reserved.
Reserved	11	Reserved.
FtsConf	12	Frequency and time synchronization (FTS) setup. Not supported.

3.5.2. BRM-STP-CONFIG2 (0x06 0x24)

Context settings. Setting the receiver to the right dynamic platform model will improve performance in the expected environment.

Type:

Get/Set.

Structure

Header	Message Group	Message Number	Length (Bytes)	Content	Checksum
0xB5 0x62	0x06	0x24	36	See *Table 29: BRM-STP-CONFIG2 Message Content.*	CHK1 CHK2

Table 29: BRM-STP-CONFIG2 Message Content

Byte Offset	C99	Scaling	Name	Unit	Description
0	uint16_t	-	Mask	-	Parameter bitmask. Only the masked parameters will be applied. See *Table 30: Mask Flag Bits.*
2	uint8_t	-	Context	-	Dynamic platform model. 0: Portable (low acceleration, generic model, valid for most use cases). 2: Stationary (used for stationary applications). 3: Pedestrian (low speed and low vertical acceleration). 4: Driving (low vertical acceleration). 5: Swimming (zero vertical velocity). 10: Biking (low heading rate of change, low vertical acceleration).
3	uint8_t[15]	-	Reserved	-	Reserved.
18	uint16_t	-	PAcc	Meter	Position accuracy.

20	uint8_t[11]	-	Reserved	-	Reserved.
31	uint8_t	-	BlindGalSearch	-	Enable blind Galileo search (when LTO is not available).
32	uint8_t[4]	-	Reserved	-	Reserved.

Table 30: *Mask* Flag Bits

Name	Flag Bits	Description
Dyn	0	1: Apply dynamic model settings.
PosMask	4	1: Apply position accuracy mask setting.
BlindGalSearch	11	1: Apply blindGalSearch settings.

3.5.3. BRM-STP-MESSAGE (0x06 0x01)

3.5.3.1.Poll a Message Setup

Type:

Query.

Structure – Poll Request

Header	Message Group	Message Number	Length (Bytes)	Content	Checksum
0xB5 0x62	0x06	0x01	2	See *Table 31: BRM-STP-MESSAGE Message Content – Poll Request.*	CHK1 CHK2

Table 31: BRM-STP-MESSAGE Message Content – Poll Request

Byte Offset	C99	Scaling	Name	Unit	Description
0	uint8_t	-	MsgGrp	-	Message group.
1	uint8_t	-	MsgNum	-	Message number.

3.5.3.2.Set Message Rate

Set message rate on current port.

Type:

Get/Set.

Structure – Set Message Rate

Header	Message Group	Message Number	Length (Bytes)	Content	Checksum
0xB5 0x62	0x06	0x01	3	See *Table 32: BRM-STP-MESSAGE Message Content – Set Message Rate.*	CHK1 CHK2

Table 32: BRM-STP-MESSAGE Message Content – Set Message Rate

Byte Offset	C99	Scaling	Name	Unit	Description
0	uint8_t	-	MsgGrp	-	Message group.
1	uint8_t	-	MsgNum	-	Message number.
2	uint8_t	-	Rate	-	Send rate on current port.

3.5.3.3.Supported Periodic Messages

Table 33: BRM-STP-MESSAGE Message Content – Set Message Rate

Message Bytes (Group and Number)	Message name	Default State
0x0104	BRM-PVT-DOP	Disabled
0x0107	BRM-PVT-PVT	Disabled
0x0109	BRM-PVT-ACC_DIST	Disabled
0x0135	BRM-PVT-SAT	Disabled
0x0161	BRM-PVT-EOE	Disabled
0x0213	BRM-ASC-SUBFRAME	Disabled

0x0215	BRM-ASC-MEAS	Disabled
0xF000	NMEA_GGA	Enabled
0xF002	NMEA_GSA	Enabled
0xF003	NMEA_GSV	Enabled
0xF004	NMEA_RMC	Enabled
0xF00D	NMEA_GNS	Enabled
0xF100	NMEA_PGLOR_SPD	Disabled
0xF101	NMEA_PGLOR_FIX	Disabled
0xF102	NMEA_PGLOR_SAT	Disabled
0xF103	NMEA_PGLOR_LSQ	Disabled
0xF104	NMEA_PGLOR_PWR	Disabled
0xF105	NMEA_PGLOR_STA	Disabled

3.5.4. BRM-STP-ME_SETTINGS (0x06 0x3E)

Configure measurement engine channels.

Type:

Get/Set.

Structure

Header	Message Group	Message Number	Length (Bytes)	Content	Checksum
0xB5 0x62	0x06	0x3E	4 + 8 * NumConfigBlocks	See *Table 34: BRM-STP-ME_SETTINGS Message Content.*	CHK1 CHK2

Table 34: BRM-STP-ME_SETTINGS Message Content

Byte Offset	C99	Scaling	Name	Unit	Description
0	uint8_t	-	MsgVer	-	Message version (0x00).

1	uint8_t	-	NumTrkChHw	-	Reserved. Number of tracking channels available in hardware (read only).
2	uint8_t	-	NumTrkChUse	-	Number of tracking channels to use. 4 < NumTrkChUse ≤ NumTrkChHw.
3	uint8_t	-	NumConfigBlocks	-	Number of configuration blocks.
Start of repeated block (*NumConfigBlocks* times)					
4 + 8 * N	uint8_t	-	GNSS_ID	-	System identifier. See *Table 43: GNSS Numbering*
5 + 8 * N	uint8_t	-	ResTrkCh	-	Reserved. Number of reserved (minimum) tracking channels for this system.
6 + 8 * N	uint8_t	-	MaxTrkCh	-	Reserved. The maximum number of tracking channels used for this system. The following conditions must be met: ● > 0. ● ≥ *ResTrkCh*. ● ≤ *NumTrkChUse*. ● ≤ the maximum number of tracking channels supported for this system.
7 + 8 * N	uint8_t	-	Reserved1	-	Reserved.
8 + 8 * N	uint32_t	-	Flags	-	Flag bits. At least one signal must be configured in every enabled system. See *Table 35: Flags Flag Bits.*
End of repeated block					

Table 35: *Flags* Flag Bits

Name	Flag Bits	Description
Enable	0	Enable this system. 1 = Enable
SigCfgMask	16 - 23	Signal setup mask. When *GNSS_ID* is 0 (GPS): ● 0x01: GPS L1 C/A. ● 0x04: GPS L5. When *GNSS_ID* is 2 (Galileo): ● 0x01: Galileo E1. ● 0x04: Galileo E5.

	When *GNSS_ID* is 3 (BeiDou): ● 0x01: BeiDou B1 (enabling this signal on an L1-only configuration forces the chip to use more hardware resources and slightly increases the power consumption). ● 0x04: BeiDou B2a. When *GNSS_ID* is 5 (QZSS): ● 0x01: QZSS L1 C/A. ● 0x04: QZSS L5. When *GNSS_ID* is 6 (GLONASS): ● 0x01: GLONASS L1. When *GNSS_ID* is 7 (NavIC): ● 0x04: NavIC L5.

3.5.5. BRM-STP-PORT (0x06 0x00)

3.5.5.1.Poll the Setup for One I/O Port

Poll the setup for one I/O port.

Type:

Query.

Structure – Poll the Setup for One I/O Port

Header	Message Group	Message Number	Length (Bytes)	Content	Checksum
0xB5 0x62	0x06	0x00	1	See *Table 36: BRM-STP-PORT Message Content – Poll the Setup for one I/O Port.*	CHK1 CHK2

Table 36: BRM-STP-PORT Message Content – Poll the Setup for one I/O Port

Byte Offset	C99	Scaling	Name	Unit	Description
0	uint8_t	-	PortID	-	Port ID. 1 = UART 4 = SPI

3.5.5.2.UART Port Setup

This message can affect baud rate and other transmission parameters. Because there may be messages queued for transmission, there may be uncertainty about which protocol applies to such messages. In addition, a message currently in transmission may be corrupted by a protocol change. Host data reception parameters may have to be changed to be able to receive future messages, including the acknowledge message resulting from the BRM-STP-PORT message.

Type:

Get/Set.

Structure - UART Port Setup

Header	Message Group	Message Number	Length (Bytes)	Content	Checksum
0xB5 0x62	0x06	0x00	20	See *Table 37: BRM-STP-PORT Message Content - UART Port Setup*.	CHK1 CHK2

Table 37: BRM-STP-PORT Message Content - UART Port Setup

Byte Offset	C99	Scaling	Name	Unit	Description
0	uint8_t	-	PortID	-	Port ID. 1 = UART
1	uint8_t	-	Reserved	-	Reserved.
2	uint16_t	-	Reserved	-	Reserved.
4	uint32_t	-	Mode	-	Hard coded as 8N1.
8	uint32_t	-	BaudRate	bps	Baud rate.
12	uint16_t	-	Reserved	-	Reserved.
14	uint16_t	-	OutProtoMask	-	Fixed as 3.
16	uint16_t	-	Flags	-	*Flags* bit mask. See *Table 38: Flags Flag Bits.*
18	uint8_t[2]	-	Reserved	-	Reserved.

Table 38: *Flags* Flag Bits

Name	Flag Bits	Description
ExtendedTxTimeout	1	Extended TX timeout. 0: The port will timeout if there is no activity for 1.5 s, regardless of the amount of allocated TX memory. 1: The port will timeout if the allocated TX memory ≥ 4 KB and there is no activity for 1.5 s.

3.5.6. BRM-STP-RESET (0x06 0x04)

Reset device and clear backup data structures.

Type:

Command.

Structure

Header	Message Group	Message Number	Length (Bytes)	Content	Checksum
0xB5 0x62	0x06	0x04	4	See *Table 39: BRM-STP-RESET Message Content.*	CHK1 CHK2

Table 39: BRM-STP-RESET Message Content

Byte Offset	C99	Scaling	Name	Unit	Description
0	uint16_t	-	NavBbrMask	-	On-chip persistent data sections to clear. The following special sets apply: 0x0000: Hot start. 0x0001: Warm start. 0xFFFF: Cold start. See *Table 40: NavBbrMask Flag Bits*
2	uint8_t	-	ResetMode	-	Reset Type. 0x01: Controlled software reset. 0x02: Controlled software reset (GNSS only). 0x08: Controlled GNSS stop. 0x09: Controlled GNSS start.
3	Uint8_t	-	Reserved	-	Reserved.

Table 40: *NavBbrMask* Flag Bits

Name	Flag Bits	Description
Eph	0	Ephemeris.
Alm	1	Almanac.
Reserved	2	Reserved.
Reserved	3	Reserved.
Pos	4	Position.
Clkd	5	Clock drift.
Reserved	6	Reserved.
UTC	7	UTC correction plus GPS leap-seconds parameters.
RTC	8	RTC.

4 Appendix A References

Table 41: Related Documents

Document Name
[1] Quectel_LC29D_AGNSS_Application_Note

Table 42: Terms and Abbreviations

Abbreviation	Description
C99	ISO/IEC 9899:1999 - Programming languages – C
DOP	Dilution of Precision
DR	Dead Reckoning
FTS	Frequency and time synchronization
ICD	Interface Control Document
GGA	Global Positioning System Fix Data
GPS	Global Positioning System
GSA	GPS DOP and Active Satellites
GSV	GPS Satellites in View
HDOP	Horizontal Dilution of Precision
HULA	Heading, UTC, Location, Altitude
LMS	Location Manager Service
LS	Location Service
LSB	Least Significant Bit

LSQ	Least Squares
LTO	Long Term Orbit
MSB	Most Significant Bit
NED	North, East, Down
NMEA	NMEA (National Marine Electronics Association) 0183 Interface Standard
PDOP	Position Dilution of Precision
PPS	Pulse Per Second
PVT	Position Velocity Time
RMC	Recommended Minimum Specific GNSS Data
RMS	Root Mean Square
RTK	Real Time Kinematic
SBAS	Satellite Based Augmentation System
SV	Satellite in View
TOW	Time of Week
UTC	Coordinated Universal Time
VDOP	Vertical Dilution of Precision
WN	Week Number
WNG	Warning

5 Appendix B GNSS Numbering

Table 43: GNSS Numbering

GNSS Type	System ID	GNSS_ID in Bream	Satellite ID	Signal ID
GPS	1	0	1–32	1 = L1 C/A 8 = L5-Q
GLONASS	2	6	65–96	1 = G1 C/A
Galileo	3	2	1–36	1 = E5a 7 = E1 B/C
BeiDou	4	3	1–46	1 = B1I 5 = B2-a
QZSS	5	5	1–10	1 = L1 C/A 8 = L5-Q
NavIC (IRNSS)	6	7	1–15	1 = L5
SBAS	-	1	33–64	-

6 Appendix C Default Configurations

Table 44: Default Configurations

Item	Default
NMEA port baud rate	115200 bps
Datum	WGS84
Rate of position fixing	1 Hz
NMEA Standard Messages	RMC, GGA, GNS GSV and GSA
GNSS Configuration	-