

L7x&LC76x Series

Difference Introduction

GNSS Module Series

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Ensure that the product may be used in the country and the required environment, as well as that it conforms to the local safety and environmental regulations.



Keep away from explosive and flammable materials. The use of electronic products in extreme power supply conditions and locations with potentially explosive atmospheres may cause fire and explosion accidents.



The product must be powered by a stable voltage source, and the wiring shall conform to security precautions and fire prevention regulations.



Proper ESD handling procedures must be followed throughout the mounting, handling and operation of any devices and equipment that incorporate the module to avoid ESD damages.

About the Document

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1 Introduction

This document offers a comparison of Quectel L70, L70-R, L76, L76-L, L76-LB, LC76F and LC76G GNSS modules. And it provides a brief summary of the most relevant features and characteristics per module. The intention of this document is to simplify the migration into the LC76G module. For more information, please contact your local FAE.

Based on the latest enhanced chipset, the new Quectel LC76G GNSS module has 2 versions. For these 2 versions, the pin, the reference design, the software protocol, and the feature sets are identical.

Following are the differences:

LC76G (PA)*: The LC76G (PA) uses a DC-DC converter and a low power LNA. It's optimized for current consumption.

LC76G (AB): LC76G (AB) contains a standard LDO and LNA inside the module. It's optimized for standard applications.

1.1 Special Marks

Table 1: Special Marks

Mark	Definition
*	Unless otherwise specified, when an asterisk (*) is used after a function, feature, interface, pin name, or argument, it indicates that the function, feature, interface, pin, or argument is under development and currently not supported; and the asterisk (*) after a model indicates that the sample of the model is currently unavailable.

2 Hardware Difference

2.1. Feature Comparison

Table 2: Feature Comparison of Single-constellation Modules and LC76G

Feature		L70	L70-R	LC76G (PA)* / LC76G (AB)
Platform		MT3339	MT3337	AG3352
GNSS Receiver Type		Single Band	Single Band	Single Band
Constellations		GPS/QZSS	GPS/QZSS	GPS/QZSS, GLONASS, Galileo and BDS
SBAS		WAAS, EGNOS, MSAS, GAGAN		
Memory Type		Flash	ROM	Flash
Power Consumption	Acquisition	18 mA	16 mA	TBD/36 mA
	Tracking	12 mA	13 mA	TBD/36 mA
	Backup	7 μ A	8 μ A	TBD/13 μ A
Sensitivity	Acquisition	-148 dBm	-148 dBm	-147 dBm ¹
	Reacquisition	-160 dBm	-160 dBm	-159 dBm ¹
	Tracking	-165 dBm	-165 dBm	-166 dBm ¹
TTF (without AGNSS)	Cold start	35 s	35 s	TBD/26 s
	Warm start	30 s	30 s	TBD/20 s
	Hot start	1 s	1 s	TBD/1 s
TTF	Cold start	15 s	15 s	TBD/12 s

¹ A different test method is used; the performance is the same as other versions.

Feature		L70	L70-R	LC76G (PA)* / LC76G (AB)
(with EASY™)	Warm start	5 s	5 s	TBD/2 s
	Hot start	1 s	1 s	TBD/1 s
TTFB (with Flash EPO™)	Cold start	-	-	TBD/5 s
Additional LNA		Optional	Optional	Integrated
Oscillator		Integrated	Integrated	Integrated
Horizontal Position Accuracy (CEP 50)		< 2.5 m	< 2.5 m	TBD/< 1.5 m
Velocity Accuracy		0.1 m/s	0.1 m/s	0.1 m/s
Acceleration Accuracy		0.1 m/s ²	0.1 m/s ²	0.1 m/s ²
Operating Temperature		-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C
Default Baud Rate		9600 bps	9600 bps	115200 bps
Power Supply		2.8–4.3 V	2.8–4.3 V	2.55–3.6 V
IO Voltage ²		2.8 V	2.8 V	VCC
Requires External Components		-	-	-

² The IO voltage is 2.8 V but could handle up to 3.1 V. Please check the relevant hardware design. It's suggested to use series resistors for all IO lines.

Table 3: Feature Comparison of Multi-constellation Modules and LC76G

Feature		L76	L76-L	L76-LB	LC76F	LC76G (PA)*/ LC76G (AB)
Platform		MT3333	MT3333	AG3331	GK9501	AG3352
GNSS Receiver Type		Single Band	Single Band	Single Band	Single Band	Single Band
Constellations		GPS/QZSS, GLONASS, Galileo, BDS	GPS/QZSS, GLONASS, Galileo, BDS	GPS/QZSS, GLONASS, BDS	GPS/QZSS, GLONASS, Galileo	GPS/QZSS, GLONASS, Galileo, BDS
Number of Concurrent Satellite Constellations		2 + QZSS	2 + QZSS	2 + QZSS	3 ³ + QZSS	4 + QZSS
SBAS		WAAS, EGNOS, MSAS, GAGAN				
Memory Type		Flash	Flash	Flash	Flash	Flash
Power Consumption	Condition	GPS + GLONASS	GPS + GLONASS	GPS + GLONASS	GPS + GLONASS	G3 + BDS + QZSS ⁴
	Acquisition	25 mA	31 mA	31 mA	30 mA	TBD/36 mA
	Tracking	18 mA	31 mA	29 mA	30 mA	TBD/36 mA
	Backup	7 µA	8 µA	8 µA	30 µA	TBD/13 µA
Sensitivity	Acquisition	-148 dBm	-149 dBm	-149 dBm	-148 dBm	-147 dBm ⁵
	Reacquisition	-160 dBm	-161 dBm	-159 dBm	-160 dBm	-159 dBm ⁵
	Tracking	-165 dBm	-167 dBm	-165 dBm	-165 dBm	-166 dBm ⁵
TTFF (without AGNSS)	Cold start	35 s	32 s	32 s	30 s	TBD/26 s
	Warm start	30 s	30 s	28 s	2 s	TBD/20 s
	Hot start	1 s	2 s	1 s	2 s	TBD/1 s
TTFF (with EASY™)	Cold start	15 s	15 s	8 s	6 s	TBD/12 s
	Warm start	5 s	5 s	6 s	2 s	TBD/2 s
	Hot start	1 s	2 s	2 s	2 s	TBD/1 s

³ Under development.

⁴ GPS + GLONASS + Galileo + BDS + QZSS.

⁵ A different test method is used; the performance is the same as other versions.

Feature			L76	L76-L	L76-LB	LC76F	LC76G (PA)*/ LC76G (AB)
TTF (with EPO™)	Cold start		-	-	-	-	TBD/5 s
Additional LNA			Optional	Integrated	Integrated	Integrated	Integrated
Oscillator			Integrated	Integrated	Integrated	Integrated	Integrated
Horizontal Position Accuracy (CEP 50)			< 2.5 m	< 2.5 m	< 2.5 m	< 2 m	TBD/< 1.5 m
Velocity Accuracy			0.1 m/s	0.1 m/s	0.1 m/s	0.1 m/s	0.1 m/s
Acceleration Accuracy			0.1 m/s ²	0.1 m/s ²	0.1 m/s ²	0.1 m/s ²	0.1 m/s ²
Operating Temperature			-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C
Default Baud Rate			9600 bps	9600 bps	9600 bps	9600 bps	115200 bps
Power Supply			2.8–4.3 V	2.8–4.3 V	2.8–4.3 V	2.8–4.3 V	2.55–3.6 V
IO Voltage ⁶			2.8 V	L76-L: 2.8 V L76-L (L): 1.8 V	L76-LB: 2.8 V L76-LB (L): 1.8 V	2.8 V	VCC
Requires External Components			-	-	-	-	-

⁶ The IO voltage is 2.8 V but could handle up to 3.1 V. Please check the relevant hardware design. It's suggested to use series resistors for all IO lines.

2.2. Module View

Since the L70, L70-R, L76, L76-L, L76-LB, LC76F and LC76G have a compatible footprint, it's easy to replace between them. The LC76G has extra 10 pins for more features. These pins can be left unconnected when replacing another module.



Figure 1: Module View

2.3. Pin Comparison

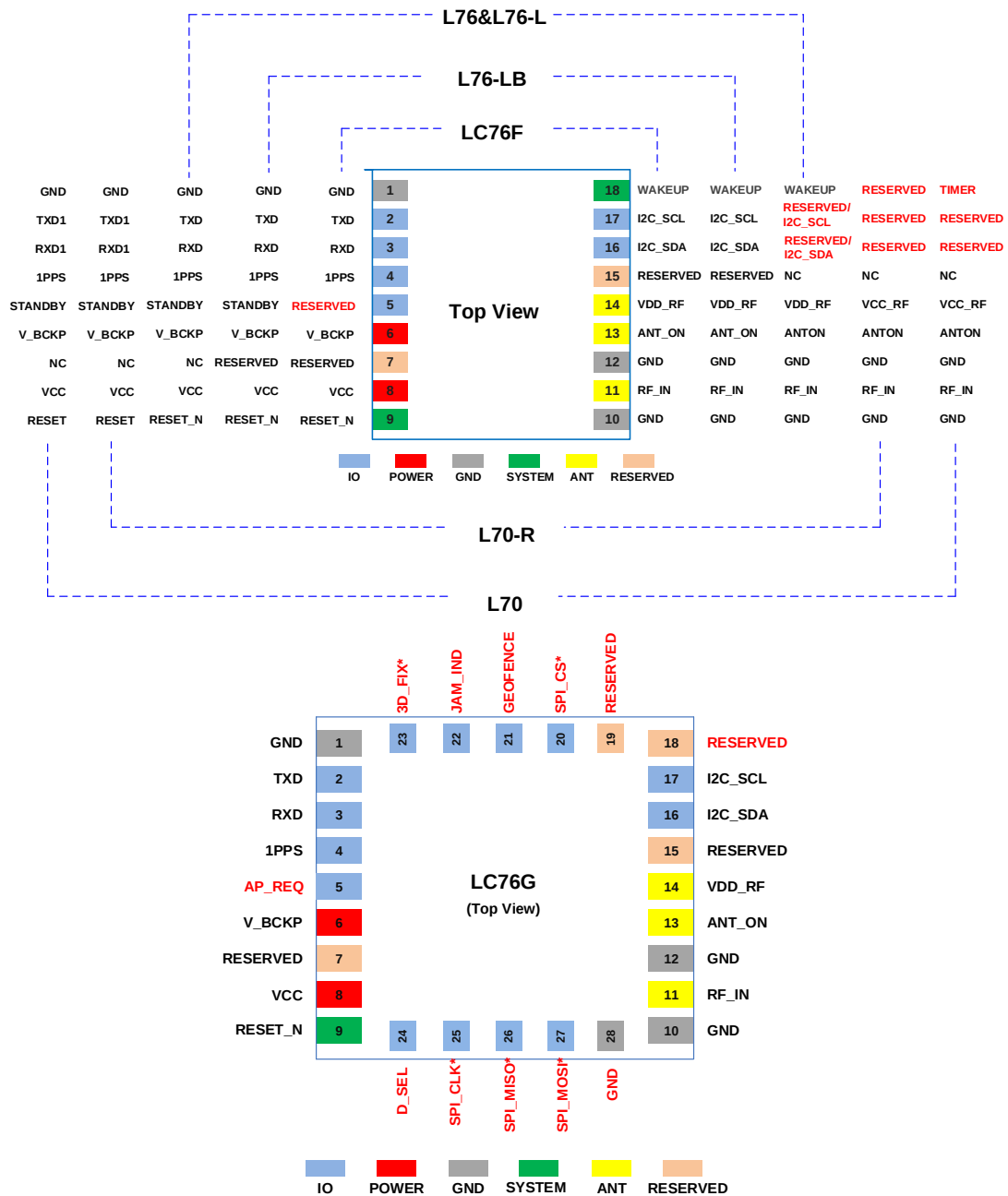


Figure 2: L70, L70-R, L76, L76-L, L76-LB, LC76F, and LC76G Pin Assignment

Table 4: Pin Comparison of Modules

Pin	L70/L70-R	L76/L76-L	L76-LB	LC76F	LC76G
1	GND	GND	GND	GND	GND
2	TXD1	TXD	TXD	TXD	TXD
3	RXD1	RXD	RXD	RXD	RXD
4	1PPS	1PPS	1PPS	1PPS	1PPS
5	STANDBY	STANDBY	STANDBY	RESERVED	AP_REQ
6	V_BCKP	V_BCKP	V_BCKP	V_BCKP	V_BCKP
7	NC	NC	RESERVED	RESERVED	RESERVED
8	VCC	VCC	VCC	VCC	VCC
9	RESET	RESET_N	RESET_N	RESET_N	RESET_N
10	GND	GND	GND	GND	GND
11	RF_IN	RF_IN	RF_IN	RF_IN	RF_IN
12	GND	GND	GND	GND	GND
13	ANTON	ANTON	ANT_ON	ANT_ON	ANT_ON
14	VCC_RF	VDD_RF	VDD_RF	VDD_RF	VDD_RF
15	NC	NC	RESERVED	RESERVED	RESERVED
16	RESERVED	RESERVED/I2C_SDA	I2C_SDA	I2C_SDA	I2C_SDA
17	RESERVED	RESERVED/I2C_SCL	I2C_SCL	I2C_SCL	I2C_SCL
18	TIMER/RESERVED	WAKEUP	WAKEUP	WAKEUP	RESERVED
19	-	-	-	-	RESERVED
20	-	-	-	-	SPI_CS *
21	-	-	-	-	GEOFENCE
22	-	-	-	-	JAM_IND
23	-	-	-	-	3D_FIX *
24	-	-	-	-	D_SEL
25	-	-	-	-	SPI_CLK *
26	-	-	-	-	SPI_MISO *
27	-	-	-	-	SPI_MOSI *
28	-	-	-	-	GND

NOTE

1. The LC76G has extra pins for SPI communication, Geo-fence, Jamming and 3D_Fix indication. For details, please refer to the relevant hardware designs.
2. Pins 16 and 17 are RESERVED for L70, L70-R, L76 and L76-L (L) and I2C_SDA and I2C_SCL for L76-L, L76-LB, LC76F, and LC76G respectively.

2.4. V_BCKP Power Supply

The same backup power supply can be applied for all modules. To ensure the correct power-up sequence, the backup unit should start up no later than the PMU. Hence, the V_BCKP must be powered simultaneously with the VCC or before it.

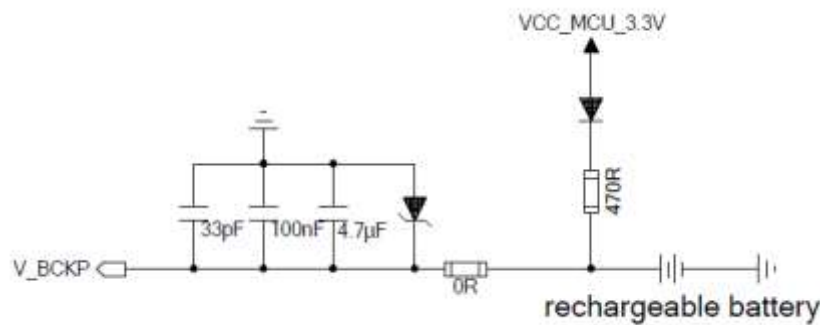


Figure 3: Decoupling Components for the V_BCKP Power Supply

The V_BCKP must be connected to power supply at startup. And it should be always powered if hot (warm) start is needed. For more information about power up sequence, see the hardware design document for the dedicated module.

2.5. VCC Power Supply

Please apply the same filter for all GNSS modules. The Zener will protect the module input from voltage peaks and surges. The capacitors should be placed close to the module and filter out all unwanted frequencies on the supply line.

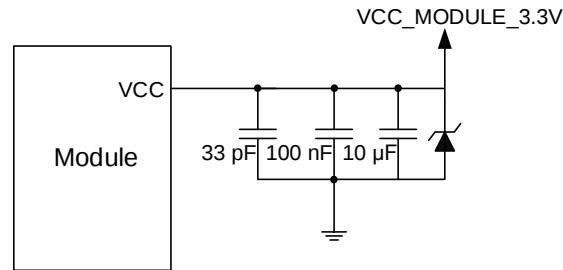


Figure 4: Decoupling Components for the VCC Power Supply

2.6. STANDBY Versus AP_REQ

STANDBY and AP_REQ pins have different functionalities. The pins are both internally pulled up, so they need an external driver circuit.

For L70, L76, L76-L and L76-LB modules:

- Pulling STANDBY pin low makes the modules enter the Standby mode.
- Releasing STANDBY pin to high makes the modules return to Continuous mode.

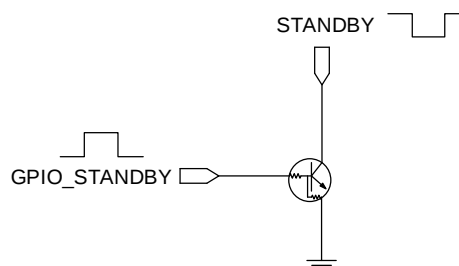


Figure 5: STANDBY Driver Circuit

For LC76G module, the AP_REQ pin is internally pulled up by default and used to ensure that commands are sent successfully.

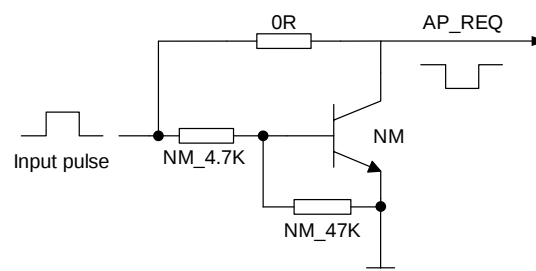


Figure 6: AP_REQ Driver Circuit

2.7. TIMER Versus WAKEUP

The L70 module uses the TIMER (pin 18) signal to control an external power switch for low power operation. L76, L76-L, L76-LB, and LC76F modules use a signal from the host (WAKEUP) to switch the integrated power switch.

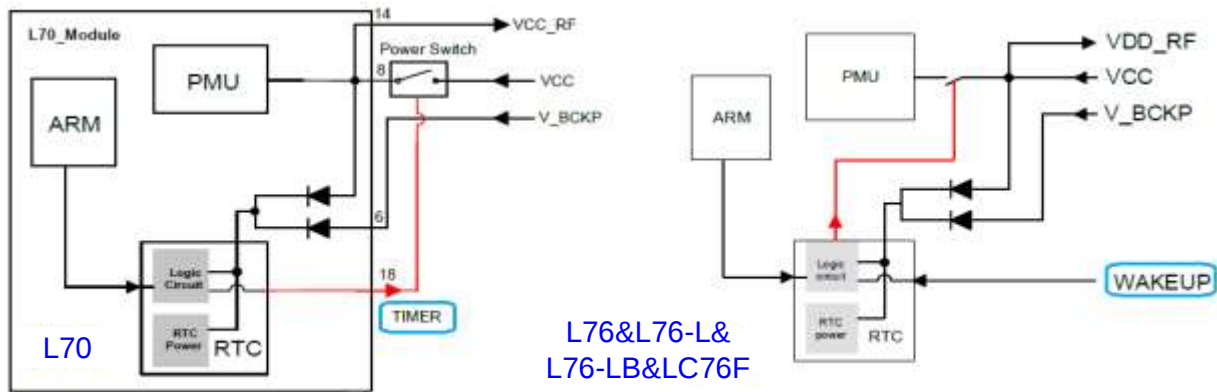


Figure 7: TIMER and WAKEUP Control Circuits

2.8. RESET_N

The RESET_N is used to reset the module from an unknown state. We see cases where customers have not protected against power surges, nor allowed for switching of power, have missing undervoltage protection or not provided enough decoupling, etc. It is strongly recommended to cater for the reset functionality in the design.

The reset function is implemented the same way for all modules. Inside the module, it's pulled up with 10 kΩ resistor to an internal voltage domain. **Therefore, it cannot be driven by a host directly and a transistor or FET circuit is needed.**

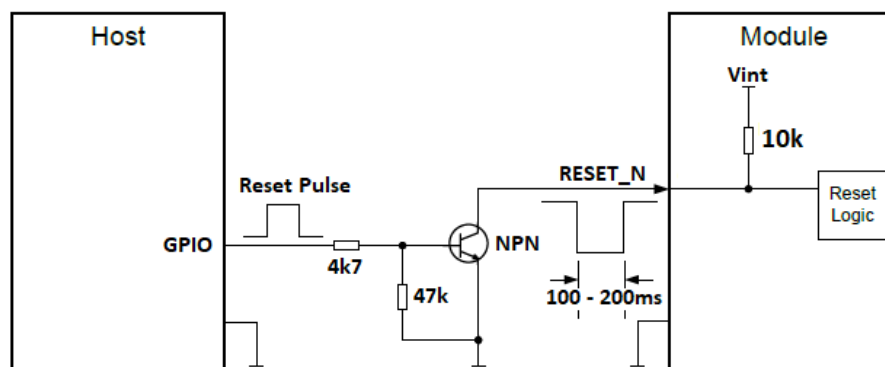


Figure 8: RESET_N Reference Circuit for All Modules

In addition, for LC76G module, the RESET_N pin is internally connected to an isolated diode. Therefore, it can also be connected to the GPIOX of the MCU through a 0 Ω resistor. Note that the **Figure 8** can also be applied to LC76G module.

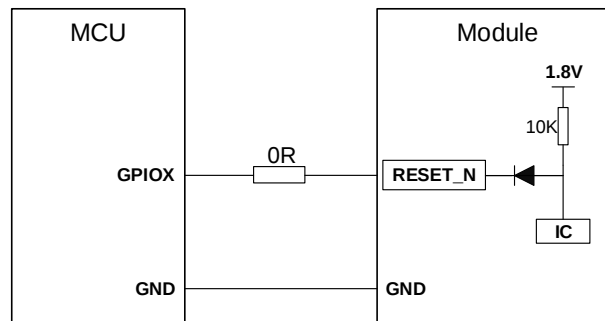


Figure 9: RESET_N Reference Circuit for LC76G

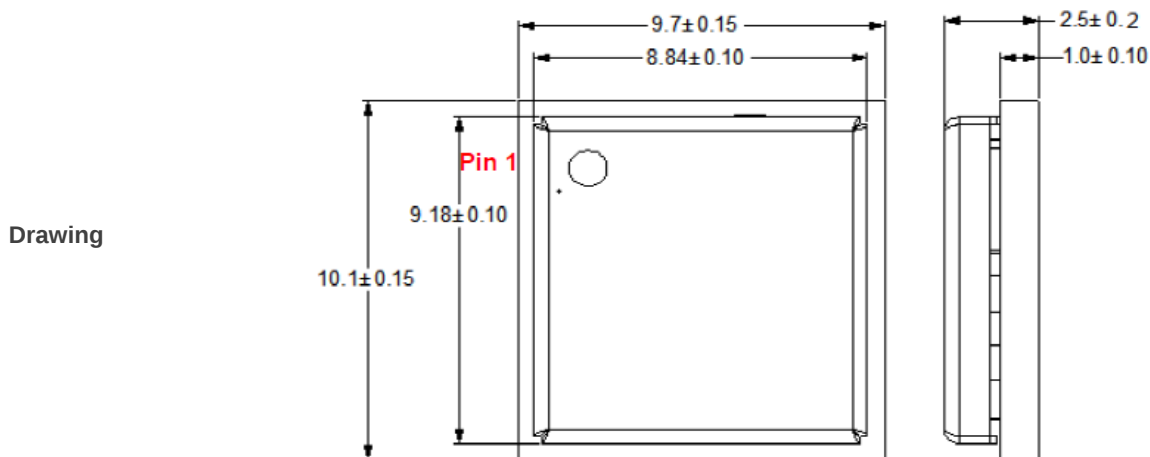
2.9. Mechanical Comparison

The following tables present the mechanical difference between the modules. For more information, please refer to the hardware design documents.

Table 5: Mechanical Comparison

Mechanical Characteristics	
L70/L70-R/L76/L76-L/L76-LB/LC76F	LC76G

Mechanical Characteristics



Length	10.1 mm	10.1 mm
Width	9.7 mm	9.7 mm
Height	2.5 mm ⁷	2.4 mm

Table 6: Weight Specification

Module	L70/L70-R	L76/L76-L	L76-LB	LC76F	LC76G
Weight (g)	0.6	0.6	0.5	0.3	0.5

2.10. Electrical Compatibility

From the table below, L76x series modules are fully compatible for voltage levels. LC76x series modules require a narrower operating voltage. The LC76G has the IO's at the power supply level, which will simplify communication circuits and reduce an LDO in the BOM.

⁷ The height of L76-LB and LC76F is 2.3 mm.

Table 7: Voltage Tolerance Comparison ⁸

Voltage Levels	L70/L70-R	L76/L76-L ⁹	L76-LB	L76-LB (L) ⁹	LC76F	LC76G
VCC	2.8–4.3 V	2.8–4.3 V	2.8–4.3 V	2.8–4.3 V	2.8–4.3 V	2.55–3.6 V
V_BCKP	1.5–4.5 V	1.5–4.5 V	2.3–4.3 V	2.3–4.3 V	2.4–4.3 V	1.65–3.6 V
RESET_N ¹⁰	-0.3–0.8 V	-0.3–0.7 V	-0.3–0.7 V	-0.3–0.45 V	-0.3–0.7 V	-0.3–0.45 V
RXD	2.8 V	2.8 V	2.8 V	1.8 V	2.8 V	VCC
TXD	2.8 V	2.8 V	2.8 V	1.8 V	2.8 V	VCC
ANT_ON	2.8 V	2.8 V	2.8 V	1.8 V	2.8 V	VCC
STANDBY	2.8 V	2.8 V	2.8 V	1.8 V	2.8 V	VCC
1PPS	2.8 V	2.8 V	2.8 V	1.8 V	2.8 V	VCC
WAKEUP	2.8 V	2.8 V	2.8 V	1.8 V	2.8 V	VCC
VDD_RF	VCC	VCC	VCC	VCC	VCC	VCC
I2C_SDA	-	-/2.8 V	2.8 V	1.8 V	2.8 V	VCC
I2C_SCL	-	-/2.8 V	2.8 V	1.8 V	2.8 V	VCC

⁸ The IO voltage is 2.8 V but could handle up to 3.1 V. Please check the relevant hardware design. It's suggested to use series resistors for all IO lines.

⁹ The L76-L (L) and L76-LB (L) versions have all IO's at 1.8 V.

¹⁰ RESET_N needs an external transistor driver, and it's internally pulled up.

3 Software Difference

3.1. Constellation

Table 8: The Supported Constellations

System	L70	L70-R	L76	L76-L	L76-LB	LC76F	LC76G
GPS	●	●	●	●	●	●	●
GLONASS	-	-	●	●	●	●	●
Galileo	-	-	●	●	-	●	●
BDS	-	-	●	●	●	-	●
QZSS	●	●	●	●	●	●	●
SBAS	●	-	●	●	●	●	●

Table 9: The Supported Constellation Combinations

Module	Combinations
L70	GPS GPS + QZSS
L70-R	GPS GPS + QZSS
L76	GPS GPS + QZSS GPS + BDS GPS + BDS + QZSS GPS + GLONASS GPS + GLONASS + QZSS GPS + GLONASS + Galileo GPS + GLONASS + Galileo + QZSS
L76-L	GPS GPS + GLONASS

Module	Combinations
	GPS + Galileo GPS + BDS GPS + QZSS GPS + GLONASS GPS + GLONASS + QZSS GPS + GLONASS + Galileo
L76-LB	GPS GPS + GLONASS GPS + BDS GPS + QZSS GPS + GLONASS GPS + GLONASS + QZSS
LC76F	GPS GPS + GLONASS GPS + Galileo GPS + GLONASS + Galileo
LC76G	GPS GPS + QZSS GPS + GLONASS GPS + GLONASS + QZSS GPS + Galileo GPS + Galileo + QZSS GPS + BDS GPS + BDS + QZSS GPS + GLONASS + Galileo + BDS GPS + GLONASS + Galileo + BDS + QZSS

3.2. AGNSS

Table 10: The Supported AGNSS

AGNSS	L70	L70-R	L76	L76-L	L76-LB	LC76F	LC76G
EASY	●	●	●	●	●	-	●
EPO	●	●	●	●	●	-	●
GPD	-	-	-	-	-	●	-
Auto-AGNSS	-	-	-	-	-	●	-

NOTE

L70-R only supports host EPO.

3.3. NMEA Protocol Differences

3.3.1. Standard NMEA Message Differences

- L70-R is compatible with NMEA V3.01 protocol.
- L70, L76, L76-L, L76-LB and LC76F are compatible with NMEA V4.10 protocol.
- LC76G is compatible with NMEA V4.11 protocol.

Table 11: The Supported NMEA Messages

Message	L70	L70-R	L76	L76-L	L76-LB	LC76F	LC76G
RMC	●	●	●	●	●	●	●
GGA	●	●	●	●	●	●	●
GSV	●	●	●	●	●	●	●
GSA	●	●	●	●	●	●	●
VTG	●	●	●	●	●	●	●
GLL	●	●	●	●	●	●	●
TXT	-	-	-	-	-	-	-
GBS	-	-	●	●	●	-	-
DTM	●	-	●	●	●	-	-

NOTE

L70, L76, L76-L, L76-LB, LC76F and LC76G have the same format in GSV, GSA, VTG, GBS and DTM if supported.

Table 12: Difference on NMEA Talker ID

GNSS Constellation Configuration	TalkerID (NMEA V3.01)	TalkerID (NMEA V4.10)	TalkerID (NMEA V4.11)
GPS	GP	GP	GP
GLONASS	-	GL	GL
Galileo	-	GA	GA
BDS	-	BD	GB
QZSS	GP	QZ	GQ
Combination of Multiple Satellite Systems	GP	GN	GN

- For L76 and L76-L, the talker ID is shown in the table below when the position is fixed. The Talker ID is always **GP** when the position is unfixed.

Table 13: Talker ID of Position Fixed

Constellation Combinations	RMC	GGA	GSA	GLL	VTG
GPS + GLONASS	GN	GP	GN	GN	GP
GPS + BDS	GP	GP	GP	GP	GP
GPS + Galileo	GN	GP	GN	GN	GP
GPS + GLONASS + Galileo	GN	GP	GN	GN	GP

- For L70 and L70-R, the talker ID is always **GP**.

NOTE

The current Talker ID of QZSS for LC76G is still **GP** and in the subsequent version, it will be fixed to **GQ**.

3.3.1.1. 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	Note
\$	-	-
<TalkerID>	String, 2 characters	-
RMC	String, 3 characters	-
<UTC>	hhmmss.sss	-
<Status>	Character	-
<Lat>	ddmm.mmmmmm	L70, L70-R, L76 and L76-L: The default length of minutes decimal fraction is 4 digits. L76-LB, LC76F and LC76G: The default length of minutes decimal fraction is 6 digits.
<N/S>	Character	-
<Lon>	dddmm.mmmmmm	L70, L70-R, L76 and L76-L: The default length of minutes decimal fraction is 4 digits. L76-LB, LC76F and LC76G: The default length of minutes decimal fraction is 6 digits.
<E/W>	Character	-
<SOG>	Numeric	-
<COG>	Numeric	-
<Date>	ddmmyy	-
<MagVar>	-	-

Field	Format	Note
<MagVarDir>	-	-
<ModeInd>	Character	-
<NavStatus>	Character	L70-R: This field does not exist.
<Checksum>	Hexadecimal	-
<CR><LF>	Character	-

3.3.1.2. 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	Note
\$	-	-
<TalkerID>	String, 2 characters	-
GGA	String, 3 characters	-
<UTC>	hhmmss.sss	-
<Lat>	ddmm.mmmmmm	L70, L70-R, L76 and L76-L: The default length of minutes decimal fraction is 4 digits. L76-LB, LC76F and LC76G: The default length of minutes decimal fraction is 6 digits.
<N/S>	Character	-
<Lon>	dddmm.mmmmmm	L70, L70-R, L76 and L76-L: The default length of minutes decimal fraction is 4 digits. L76-LB, LC76F and LC76G: The default length of minutes decimal fraction is 6 digits.

Field	Format	Note
<E/W>	Character	-
<Quality>	Numeric, 1 digit	-
<NumSatUsed> ¹⁾	Numeric, 2 digits	-
<HDOP>	Numeric	-
<Alt>	Numeric	L70, L70-R, L76, L76-L: The default length of decimal fraction is 1 digit. L76-LB, LC76F and LC76G: The default length of decimal fraction is 3 digits.
M	Character	-
<Sep>	Numeric	L70, L70-R, L76, L76-L: The default length of decimal fraction is 1 digit. L76-LB, LC76F and LC76G: The default length of decimal fraction is 3 digits.
M	Character	-
<DiffAge>	-	-
<DiffStation>	-	-
<Checksum>	Hexadecimal	-
<CR><LF>	Character	-

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⁾ According to the NMEA 0183 specification, the number of satellites in use is between 00 and 12. However, in the multi-constellation solution, the number of satellites in use may exceed 12.

3.3.1.3. GSV

GNSS Satellites in View. The GSV sentence provides the number of satellites in view (SV), satellite ID numbers, elevation, azimuth, and SNR value, and it 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 data fields.

Type:

Output

Synopsis:

```
$<TalkerID>GSV,<TotalNumSen>,<SenNum>,<TotalNumSat>{,<SatID>,<SatElev>,<SatAz>,<SatCN0>},<SignalID>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Note
\$	-	-
<TalkerID>	String, 2 characters	-
GSV	String, 3 characters	-
<TotalNumSen>	Numeric	L70-R: Number of messages. Range: 1-3 . L70, L76, L76-L L76-LB, LC76F and LC76G: Number of messages. Range: 1-9 .
<SenNum>	Numeric	-
<TotalNumSat>	Numeric	-
Start of repeat block. Repeat times: 1-4.		
<SatID>	Numeric	-
<SatElev>	Numeric	-
<SatAz>	Numeric	-
<SatCN0>	Numeric	-
End of repeat block.		
<SignalID>	Numeric	L70-R: This field does not exist.
<Checksum>	Hexadecimal	-
<CR><LF>	Character	-

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.

3.3.1.4. GSA

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

Type:

Output

Synopsis:

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

Parameter:

Field	Format	Note
\$	-	
<TalkerID>	String, 2 characters	L70-R: Always “GP”. L70, L76, L76-L L76-LB, LC76F and LC76G: See Table 12: Difference on NMEA Talker ID
GSA	String, 3 characters	-
<Mode>	Character	-
<FixMode>	Numeric	-
Start of repeat block. Repeat times: 12.		
<SatID>	Numeric	-
End of repeat block.		
<PDOP>	Numeric	-
<HDOP>	Numeric	-
<VDOP>	Numeric	-
<SystemID>	Numeric	L70-R: This field does not exist.
<Checksum>	Hexadecimal	-
<CR><LF>	Character	-

NOTE

1. L70, L70-R, L76, L76-L L76-LB and LC76F: 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. LC76G: None of the above restrictions.

3.3.1.5. VTG

Course Over Ground & Ground Speed. The actual course and speed relative to the ground.

Type:

Output

Synopsis:

```
$<TalkerID>VTG,<COGT>,T,<COGM>,M,<SOGN>,N,<SOGK>,K,<ModeInd>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Note
\$	-	-
<TalkerID>	String, 2 characters	-
VTG	String, 3 characters	-
<COGT>	Numeric	L70-R: The default length of minutes decimal fraction is 1 digit. L70, L76, L76-L, L76-LB, LC76F and LC76G: The default length of minutes decimal fraction is 2 digits.
T	Character	-
<COGM>	Numeric	-
M	Character	-
<SOGN>	Numeric	L70-R: The default length of minutes decimal fraction is 1 digit. L70, L76, L76-L, L76-LB, LC76F and LC76G: The default length of minutes decimal fraction is 2 digits.
N	Character	-

Field	Format	Note
<SOGK>	Numeric	L70-R: The default length of minutes decimal fraction is 1 digit. L70, L76, L76-L, L76-LB, LC76F and LC76G: The default length of minutes decimal fraction is 2 digits.
K	Character	-
<ModeInd>	Character	-
<Checksum>	Hexadecimal	-
<CR><LF>	Character	-

3.3.1.6. GLL

Geographic Position – Latitude/Longitude. Latitude and longitude of the GNSS receiver position, the time of position fix and status.

Type:

Output

Synopsis:

```
$<TalkerID>GLL,<Lat>,<N/S>,<Lon>,<E/W>,<UTC>,<Status>,<ModeInd>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Note
\$	-	-
<TalkerID>	String, 2 characters	-
GLL	String, 3 characters	-
<Lat>	ddmm. mmmmmm	L70, L76, L70-R and L76-L: The default length of minutes decimal fraction is 4 digits. L76-LB, LC76F and LC76G: The default length of minutes decimal fraction is 6 digits.
<N/S>	Character	-
<Lon>	dddmm. mmmmmm	L70, L76, L70-R and L76-L: The default length of minutes decimal fraction is 4 digits. L76-LB, LC76F and LC76G: The default length of

Field	Format	Note
		minutes decimal fraction is 6 digits.
<E/W>	Character	-
<UTC>	hhmmss.sss	-
<Status>	Character	-
<ModelInd>	Character	-
<Checksum>	Hexadecimal	-
<CR><LF>	Character	-

3.3.2. PMTK Versus PAIR Versus PGKC Messages

PMTK messages are supported by Quectel L70, L70-R, L76-L and L76-LB.

PGKC messages are supported by Quectel LC76F.

PAIR messages are supported by Quectel LC76G.

Table 14: Difference on PMTK, PAIR and PGKC Messages

L70	L76/L76-L/ L76-LB	L70-R	LC76F	LC76G	Description
PMTK001	PMTK001	PMTK001	PGKC001	PAIR001	Acknowledge message.
-	-	-	-	PAIR002	Powers on the GNSS system.
-	-	-	-	PAIR003	Powers off the GNSS system.
PMTK161	PMTK161	-	PGKC105	-	Enables/disables Standby mode.
PMTK011	PMTK011	PMTK011	-	-	Automatically outputs text message when the modules are powered up.
PMTK101	PMTK101	PMTK101	PGKC030	PAIR004	Performs a hot start.
PMTK102	PMTK102	PMTK102	PGKC030	PAIR005	Performs a warm start.
PMTK103	PMTK103	PMTK103	PGKC030	PAIR006	Performs a cold start.
PMTK104	PMTK104	PMTK104	PGKC030	PAIR007	Performs a cold start and

L70	L76/L76-L/ L76-LB	L70-R	LC76F	LC76G	Description
					clears system and user configurations at the start.
PMTK010	PMTK010	PMTK010	-	PAIR010	Automatically outputs system message when the modules are powered up.
PMTK220	PMTK220	PMTK220	PGKC101	PAIR050	Sets position fix interval.
-	-	PMTK500 PMTK400	PGKC201	PAIR051	Gets the position fix interval.
-	-	-	-	PAIR058	Sets the minimum SNR of satellites in use.
-	-	-	-	PAIR059	Gets the minimum SNR of satellites in use.
PMTK314	PMTK314	PMTK314	PGKC242	PAIR062	Sets NMEA sentence output frequencies.
-	-	-	PGKC243	PAIR063	Gets NMEA sentence output frequency.
-	-	-	PGKC147	-	Only sets the NMEA port baud rate.
PMTK352	PMTK352 PMTK353	PMTK352	PGKC115 PGKC121	PAIR066	Sets the GNSS search mode.
-	-	-	-	PAIR067	Gets the GNSS search mode.
PMTK386	PMTK386	-	PGKC284	PAIR070	Sets the static navigation speed threshold.
-	-	-	-	PAIR071	Gets the static navigation speed threshold.
-	PMTK311	-	-	PAIR072	Sets satellite elevation mask.
-	-	-	-	PAIR073	Gets satellite elevation mask.
PMTK286	PMTK286	PMTK286	-	PAIR074	Enables/disables AIC function.
-	-	-	-	PAIR075	Queries AIC function.
PMTK886	PMTK886	PMTK886	PGKC786	PAIR080	Sets navigation mode.
-	-	-	-	PAIR081	Queries navigation mode.
-	-	-	-	PAIR086	Enables/disables debug log output in binary format.
-	-	-	-	PAIR087	Queries the debug log output

L70	L76/L76-L/ L76-LB	L70-R	LC76F	LC76G	Description
					setting.
-	-	-	-	PAIR098	Sets the coordinate precision.
-	-	-	-	PAIR099	Queries the precision of coordinates.
-	-	-	-	PAIR382	Enables/disables to lock system Standby mode.
PMTK838	PMTK838	-	-	PAIR391	Enables/disables jamming detection.
PMTK301	PMTK301	PMTK301	-	PAIR400	Sets the source mode of DGPS correction data.
PMTK401	PMTK401	PMTK401	-	PAIR401	Queries the setting of DGPS mode.
PMTK313	PMTK313	-	PGKC239	PAIR410	Enables/disables the search of SBAS satellites.
PMTK413 PMTK513	PMTK413 PMTK513	-	PGKC240	PAIR411	Queries the status of SBAS satellite search.
-	-	-	-	PAIR432	Sets RTCM output mode.
-	-	-	-	PAIR433	Queries RTCM output mode.
PMTK869	PMTK869	PMTK869	-	PAIR490	Enables/disables EASY function.
-	-	-	-	PAIR491	Queries the status of EASY function.
-	-	-	-	PAIR511	Saves current navigation data from RTC RAM to flash.
-	-	-	-	PAIR513	Saves the current configurations from RTC RAM to flash.
-	-	-	PGKC639	PAIR590	Sends current UTC time to GNSS chip for faster TTFF.
-	-	-	PGKC639	PAIR600	Sends reference location to GNSS chip for faster TTFF.
-	-	-	PGKC105	PAIR650	Powers off the GNSS system, except the clock.
PMTK285	PMTK285	PMTK285	PGKC161	PAIR752	Sets PPS configurations.
-	-	-	PGKC147	PAIR864	Sets the baud rate of UART interface.

L70	L76/L76-L/ L76-LB	L70-R	LC76F	LC76G	Description
-	-	-	-	PAIR865	Gets the baud rate of UART interface.
-	-	-	-	PAIR866	Sets UART flow control.
-	-	-	-	PAIR867	Gets UART flow control setting.
-	-	-	-	PAIR890	Sets geofence configuration.
-	-	-	-	PAIR891	Queries the GEOFENCE configuration.
-	-	-	-	PAIR892	Sets GPIO polarity for GEOFENCE combined state.
-	-	-	PGKC040	-	Erases almanac and ephemeris information on the flash.
-	-	-	PGKC047	-	Clears the GPD file in the Flash.
-	-	-	PGKC105	PAIR003/ PAIR650	Puts the modules to low power mode.
-	-	-	PGKC279	-	Queries RTC time.
-	-	-	PGKC356	-	Sets the HDOP threshold value.
-	-	-	PGKC357	-	Gets the HDOP threshold value.
-	-	-	PGKC462	-	Queries the current software version.
PMTK183	PMTK183	-	-	-	Queries the LOCUS logging status.
PMTK184	PMTK184	-	-	-	Erases the LOCUS logger flash data.
PMTK185	PMTK185	-	-	-	Stops or starts LOCUS data logging.
PMTK225	PMTK225	-	PGKC105	-	Sets the modules to Periodic mode for power saving.

3.3.3. PQ Messages

PQ messages are supported by Quectel L76, L70, L76-L and L76-LB.

Table 15: PQ Messages Matching

L76	L76-L	L76-LB	L70	L70-R	LC76F	LC76G	Description
PQBAUD	PQBAUD	PQBAUD	PQBAUD	-	PGKC147	PAIR864	Sets NMEA port default baud rate.
PQEPE	PQEPE	PQEPE	PQEPE	-	-	-	Enables/disables PQEPE message output.
PQ1PPS	PQ1PPS	PQ1PPS	PQ1PPS	-	PGKC161	PAIR752	Sets the type and pulse width of 1PPS output.
-	-	-	PQFLP	-	-	-	Sets the modules into FLP mode and gets module operation mode.
PQTXT	PQTXT	PQTXT	PQTXT	-	-	-	Enables/disables GPTXT message output.
PQECEF	PQECEF	PQECEF	PQECEF	-	-	-	Enables/disables ECEFPOSVEL message output.
ECEFPO SVEL	ECEFPO SVEL	ECEFPO SVEL	ECEFPO SVEL	-	-	-	This message is automatically output when PQECEF is enabled.
PQODO	PQODO	PQODO	PQODO	-	-	-	Starts/stops odometer reading.
PQPZ90	PQPZ90	PQPZ90	PQPZ90	-	-	-	Enables/disables switching from WGS84 to PZ-90.11.
PQGLP	PQGLP	PQGLP	-	-	-	-	Sets the modules to GLP mode and gets whether the GLP mode is enabled.

L76	L76-L	L76-LB	L70	L70-R	LC76F	LC76G	Description
PQVEL	PQVEL	PQVEL	PQVEL	-	-	-	Enables/disables PQVEL message output.
PQJAM	PQJAM	PQJAM	PQJAM	-	-	PAIR391	Enables/disables jamming detection function.
PQRLM	PQRLM	-	-	-	-	-	Enables/disables the return link message output.
PQGEO	-	-	-	-	-	PAIR890	Configures parameters of Geo-fence.
PQPREC	PQPREC	PQPREC	-	-	-	PAIR098	Configures the parameter (latitude/longitude/altitude) in NMEA sentences through setting the number of digits after the decimal point.
PQGBS	PQGBS	PQGBS	-	-	-	-	Enables/disables GBS message output.
PQVERN O	PQVERN O	PQVERN O	PQVERN O	-	PGKC462	PQTMVE RNO	Queries the information about firmware version.

4 Appendix A References

Table 16: Related Documents

Document Name
[1] Quectel L70 Hardware Design
[2] Quectel L70-R Series Hardware Design
[3] Quectel L76&L76-L Hardware Design
[4] Quectel L76-LB Hardware Design
[5] Quectel LC76F Hardware Deisgn
[6] Quectel LC76G Series Hardware Deisgn
[7] Quectel_L70_Reference_Design
[8] Quectel_L70-R_Series_Reference_Design
[9] Quectel_L76&L76-L_Reference_Design
[10] Quectel_L76-LB_Reference_Design
[11] Quectel_LC76F_Reference_Design
[12] Quectel_LC76G_Series_Reference_Design
[13] Quectel LC76F GNSS Protocol Specification
[14] Quectel Lx0&Lx6&LC86L&LG77L GNSS Protocol Specification
[15] Quectel LC26G&LC76G&LC86G Series GNSS Protocol Specification

Table 17: Terms and Abbreviations

Abbreviation	Description
AGNSS	Assisted GNSS (Global Navigation Satellite System)
AIC	Active Interference Cancellation
BDS	BDS Satellite Navigation System
BOM	Bill of Materials
bps	bit(s) per second
CLK	SPI Serial Clock
CEP	Circular Error Probable
COGM	Course over Ground (in Magnetic North Course Direction)
COGT	Course over Ground (in True North Course Direction)
DGPS	Differential Global Positioning System
EASY	Embedded Assist System
EGNOS	European Geostationary Navigation Overlay Service
EPO	Extended Prediction Orbit
ESD	Electrostatic Discharge
FET	Field Effect Transistor
GAGAN	GPS Aided Geo Augmented Navigation
Galileo	Galileo Satellite Navigation System (EU)
GLONASS	Global Navigation Satellite System (Russia)
GNSS	Global Navigation Satellite System
GPD	Geographic Position Data
GPS	Global Positioning System
GSA	GNSS DOP and Active Satellites
GSV	GNSS Satellites in View
HDOP	Horizontal Dilution of Precision
IO	Input/Output

Abbreviation	Description
I2C	Inter-Integrated Circuit
LDO	Low-dropout Regulator
LNA	Low-Noise Amplifier
MISO	Master In Slave Out
MOSI	Master Out Slave In
MSAS	Multi-functional Satellite Augmentation System (Japan)
NMEA	NMEA (National Marine Electronics Association) 0183 Interface Standard
PMU	Power Management Unit
1PPS	One Pulse Per Second
QZSS	Quasi-Zenith Satellite System
RF	Radio Frequency
RMC	Recommended Minimum Specific GNSS Data
RTC	Real-Time Clock
RXD	Receive Data (Pin)
SBAS	Satellite-Based Augmentation System
SNR	Signal to Noise Ratio
SOG	Speed over Ground
SPI	Serial Peripheral Interface
TBD	To Be Determined
TTFF	Time to First Fix
TXD	Transmit Data (Pin)
TXT	Text Transmission
UART	Universal Asynchronous Receiver/Transmitter
UTC	Coordinated Universal Time
VCC	Supply Voltage
VTG	Course Over Ground & Ground Speed

Abbreviation	Description
WAAS	Wide Area Augmentation System
WGS84	World Geodetic System 1984

5 Appendix B GNSS Numbering

Table 18: GNSS Constellations Information

GNSS Type	System ID	Satellite ID	Signal ID
GPS	1	1–32	1 = L1 C/A
GLONASS	2	65–96	1 = G1 C/A
Galileo	3	1–36	6 = E1A 7 = E1BC
BDS	4	1–63	1 = B1I
QZSS	5	193–199	1 = L1 C/A
SBAS	-	33–64	-

NOTE

This GNSS Numbering is only applicable to LC76G and may vary depending on modules. For more information, see GNSS protocol specification document for the dedicated module.