L8x&LC86x Series

Difference Introduction

GNSS Module Series

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	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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Contents

Table Index

Figure Index

1 Introduction

This document compares Quectel L80, L80-R, L86, LC86L (A, B, C), and LC86G (AA, AB*, LA) GNSS modules. It provides a brief summary of their most relevant features and characteristics. The intention of this document is to simplify the migration to the new Quectel LC86G GNSS module. For more information, contact your local FAE.

Based on the latest enhanced chipset, LC86G series includes 3 module versions whose pins, reference designs and software protocols are identical.

Differences between versions are listed below:

LC86G (AA): LC86G (AA) has 16.0 mm × 16.0 mm × 6.95 mm patch antenna, which supports GPS + Galileo + BDS + QZSS by default.

LC86G (AB)*: LC86G (AB)* has 16.0 mm × 16.0 mm × 6.95 mm patch antenna, which supports GPS + GLONASS + Galileo + QZSS by default.

LC86G (LA): LC86G (LA) has 18.4 mm × 18.4 mm × 6.95 mm patch antenna, which supports GPS + GLONASS + Galileo + BDS + QZSS by default.

1.1 Special Mark

Table 1: Special Mark

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 Differences

2.1. Feature Comparison

Table 2: Feature Comparison of Single-Constellation Modules and LC86G

Feature		L80	L80-R	LC86G (LA)	LC86G (AA)	LC86G (AB)*
Platform		MT3339	MT3339	AG3352	AG3352	AG3352
GNSS Receiver Type		Single Band	Single Band	Single Band	Single Band	Single Band
Constellations		GPS/QZSS	GPS/QZSS	GPS/QZSS, GLONASS, Galileo, BDS	GPS/QZSS, Galileo, BDS	GPS/QZSS, GLONASS, Galileo
Number of Concurrent Satellite Constellations		1+ QZSS	1+ QZSS	4 + QZSS	3 + QZSS	3 + QZSS
SBAS (WAAS, EGNOS, MSAS, GAGAN)		Supported	-	Supported	Supported	Supported
Memory Type		Flash	Flash	Flash	Flash	Flash
Power Consumption	Constellations	GPS	GPS	GPS + GLONASS + Galileo + BDS + QZSS	GPS + Galileo + BDS	GPS + GLONASS + Galileo
	Acquisition	25 mA	25 mA	32 mA	32 mA	TBD

Feature		L80	L80-R	LC86G (LA)	LC86G (AA)	LC86G (AB)*
	Tracking	20 mA	20 mA	32 mA	32 mA	TBD
	Backup	7 μA	7 μA	14 μA	14 μA	TBD
Sensitivity	Acquisition	-148 dBm	-148 dBm	-147 dBm	-147 dBm	-147 dBm
	Reacquisition	-160 dBm	-160 dBm	-160 dBm	-160 dBm	-160 dBm
	Tracking	-165 dBm	-165 dBm	-166 dBm	-166 dBm	-166 dBm
TTFF (without AGNSS)	Cold start	35 s	35 s	25 s	25 s	25 s
	Warm start	30 s	30 s	22 s	22 s	22 s
	Hot start	1 s	1 s	1 s	1 s	1 s
TTFF (with EASY)	Cold start	15 s	15 s	12 s	12 s	12 s
	Warm start	5 s	5 s	2 s	2 s	2 s
	Hot start	1 s	1 s	1 s	1 s	1 s
TTFF (with Flash EPO)	Cold start	5 s	-	5 s	5 s	5 s
Additional LNA		Supported	Supported	Supported	Supported	Supported
Oscillator		Integrated	Integrated	Integrated	Integrated	Integrated
Horizontal Position Accuracy (CEP 50)		2.5 m	2.5 m	1.5 m	1.5 m	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

Feature	L80	L80-R	LC86G (LA)	LC86G (AA)	LC86G (AB)*
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	115200 bps	115200 bps	115200 bps
Power Supply	2.8–4.3 V	2.8–4.3 V	2.55–3.6 V	2.55–3.6 V	2.55–3.6 V
IO Voltage [1]	2.8 V	2.8 V	VCC	VCC	VCC
Requires External Components	-	-	-	-	-

Table 3: Feature Comparison of Multi-Constellation Modules and LC86G

Feature	L86	LC86L (A)	LC86L (B)	LC86L (C)	LC86G (LA)	LC86G (AA)	LC86G (AB)*
Platform	MT3333	AG3331	AG3331	MT3333	AG3352	AG3352	AG3352
GNSS Receiver Type	Single Band	Single Band	Single Band	Single Band	Single Band	Single Band	Single Band
Constellations	GPS/QZSS, GLONASS, Galileo, BDS	GPS/QZSS, GLONASS, BDS	GPS/QZSS, GLONASS, BDS	GPS/QZSS, GLONASS, Galileo, BDS	GPS/QZSS, GLONASS, Galileo, BDS	GPS/QZSS, Galileo, BDS	GPS/QZSS, GLONASS, Galileo
Number of Concurrent Satellite Constellations	4 + QZSS	3 + QZSS	3 + QZSS	4 + QZSS	4 + QZSS	3+ QZSS	3 + QZSS
SBAS	WAAS, EGNOS, MSAS, GAGAN						

[1] For L80 and L80-R modules, the IO voltage is 2.8 V but they could handle up to 3.1 V. Please check the relevant hardware design for more information about IO voltage. It's suggested to use resistors in series for all IO lines.

Feature		L86	LC86L (A)	LC86L (B)	LC86L (C)	LC86G (LA)	LC86G (AA)	LC86G (AB)*
Memory Type		Flash	Flash	Flash	Flash	Flash	Flash	Flash
Power Consumption	Constellations	GPS + GLONASS	GPS + GLONASS	GPS + BDS	GPS + GLONASS	G3 [2] + BDS + QZSS	G2 [2] + BDS	G3 [2]
	Acquisition	30 mA	32 mA	33 mA	32 mA	32 mA	32 mA	TBD
	Tracking	26 mA	31 mA	30 mA	30 mA	32 mA	32 mA	TBD
	Backup	7 μA	6 μA	6 μA	7 μA	14 μA	14 μA	TBD
Sensitivity	Acquisition	-149 dBm	-148 dBm	-148 dBm	-148 dBm	-147 dBm	-147 dBm	-147 dBm
	Reacquisition	-161 dBm	-161 dBm	-161 dBm	-162 dBm	-160 dBm	-160 dBm	-160 dBm
	Tracking	-167 dBm	-166 dBm	-166 dBm	-166 dBm	-166 dBm	-166 dBm	-166 dBm
TTFF (without AGNSS)	Cold start	35 s	35 s	35 s	35 s	25 s	25 s	25 s
	Warm start	30 s	30 s	30 s	30 s	22 s	22 s	22 s
	Hot start	1 s	2 s	2 s	2 s	1 s	1 s	1 s
TTFF (with EASY)	Cold start	15 s	15 s	15 s	15 s	12 s	12 s	12 s
	Warm start	5 s	5 s	5 s	5 s	2 s	2 s	2 s
	Hot start	1 s	2s	2 s	2 s	1 s	1 s	1 s
TTFF (with Flash EPO)	Cold start	5 s	4 s	4 s	4 s	5 s	5 s	5 s

[2] G3 is GPS + GLONASS + Galileo; G2 is GPS + Galileo.

Feature	L86	LC86L (A)	LC86L (B)	LC86L (C)	LC86G (LA)	LC86G (AA)	LC86G (AB)*
Additional LNA	Supported	Supported	Supported	Supported	Supported	Supported	Supported
Oscillator	Integrated	Integrated	Integrated	Integrated	Integrated	Integrated	Integrated
Horizontal Position Accuracy (CEP50)	2.5 m	2.5 m	2.5 m	2.5 m	1.5 m	1.5 m	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	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	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	-40°C to +85 °C	-40°C to +85 °C
Default Baud Rate	9600 bps	9600 bps	9600 bps	9600 bps	115200 bps	115200 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	2.55–3.6 V	2.55–3.6 V
IO Voltage [3]	2.8 V	2.8 V	2.8 V	2.8 V	VCC	VCC	VCC
Requires External Components	-	-	-	-	-	-	-

[3] For L86 and LC86L modules, the IO voltage is 2.8 V but could handle up to 3.1 V. Please check the relevant hardware design for more information about IO voltage. It's suggested to use resistors in series for all IO lines.

2.2. Module View

The footprint of L80, L80-R, L86 and LC86L is compatible and interchangeable with LC86G series. LC86G has extra 24 GND pins, which can be left unconnected when replacing a compatible module on the same PCB. You should modify your PCB design since these additional ground pins provide enhanced mechanical stability for module applications in harsh and high vibration environments.

Figure 1: Module View

2.3. Pin Comparison

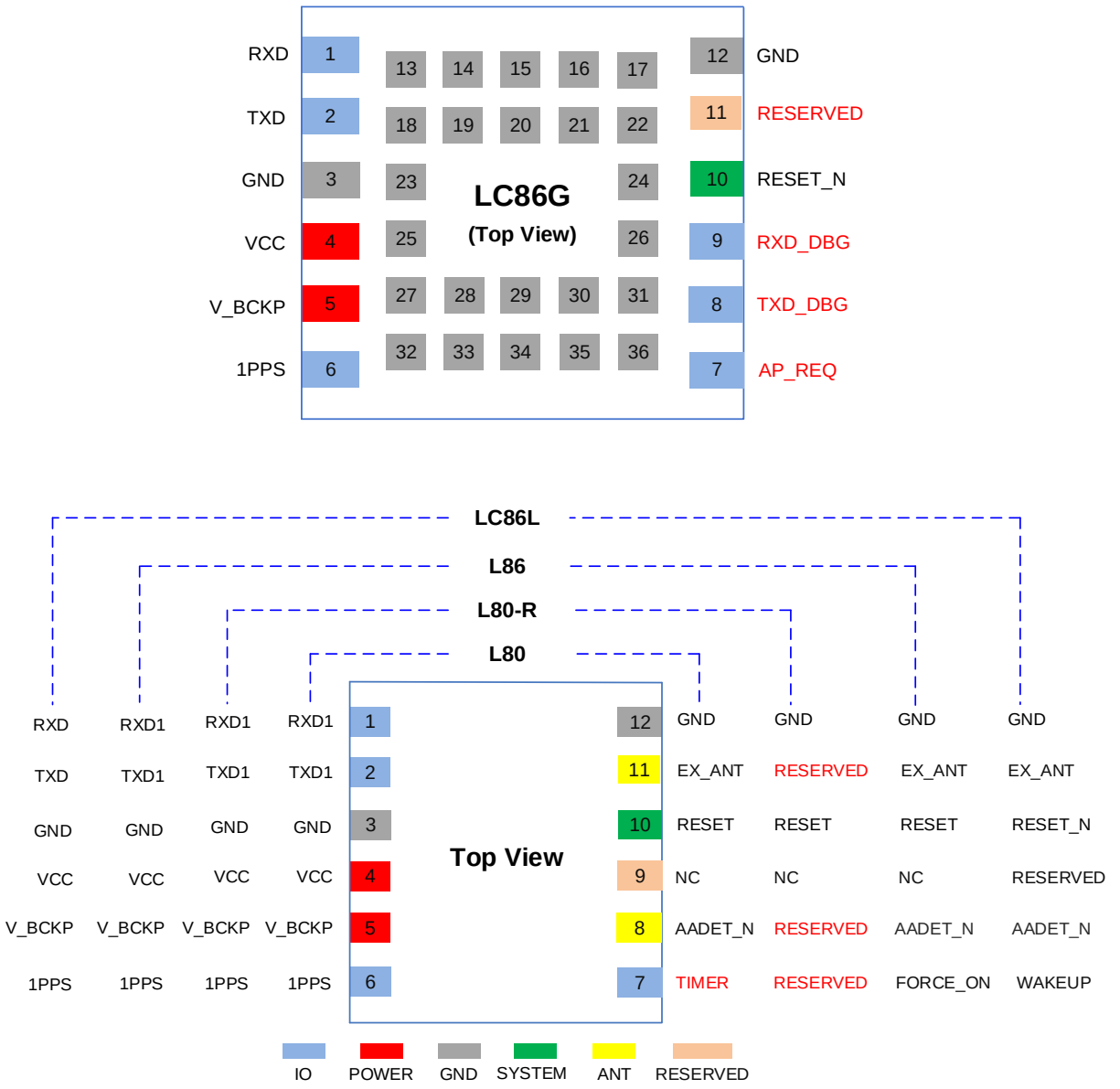


Figure 2: L80, L80-R, L86, LC86L, and LC86G Pin Assignment

Table 4: Pin Comparison

Pin	L80	L80-R	L86	LC86L	LC86G
1	RXD1	RXD1	RXD1	RXD	RXD
2	TXD1	TXD1	TXD1	TXD	TXD
3	GND	GND	GND	GND	GND
4	VCC	VCC	VCC	VCC	VCC
5	V_BCKP	V_BCKP	V_BCKP	V_BCKP	V_BCKP
6	1PPS	1PPS	1PPS	1PPS	1PPS
7	TIMER	RESERVED	FORCE_ON	WAKEUP	AP_REQ
8	AADET_N	RESERVED	AADET_N	AADET_N	TXD_DBG
9	NC	NC	NC	RESERVED	RXD_DBG
10	RESET	RESET	RESET	RESET_N	RESET_N
11	EX_ANT	RESERVED	EX_ANT	EX_ANT	RESERVED
12	GND	GND	GND	GND	GND
13–36	-	-	-	-	GND

2.4. V_BCKP Power Supply

The same backup power supply can be applied to 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.

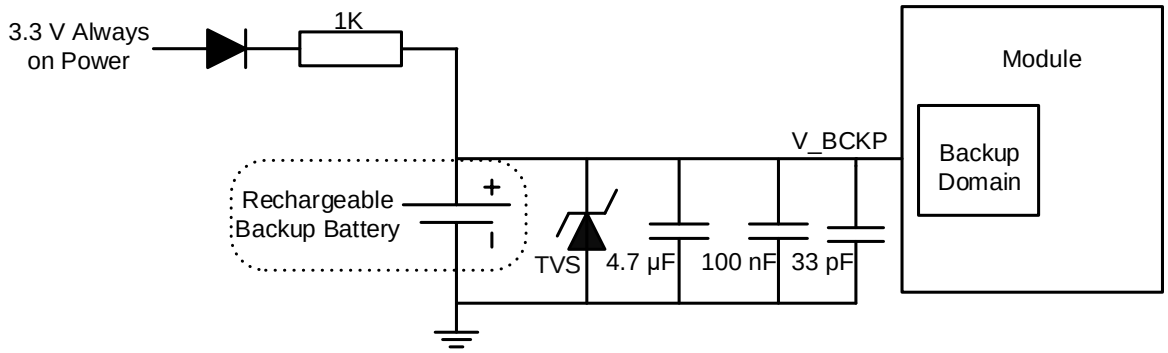


Figure 3: Decoupling Components for V_BCKP Power Supply

The V_BCKP must be connected to power supply at startup, and it should always be 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 to all GNSS modules. A Zener will protect module input from voltage peaks and surges. Capacitors should be placed close to the module to filter out all unwanted frequencies on the supply line.

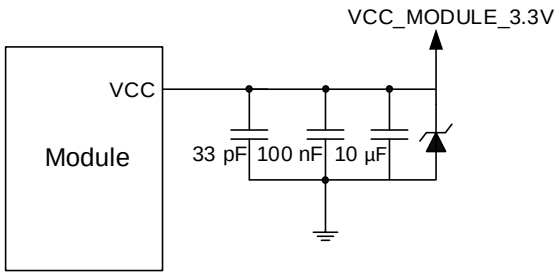


Figure 4: Decoupling Components for VCC Power Supply

2.6. AP_REQ

To ensure successful command reception on LC86G, send the command within 100 ms after pulling AP_REQ pin low.

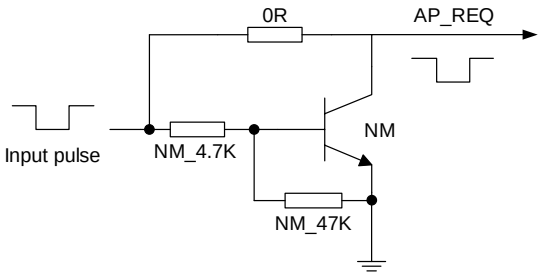


Figure 5: AP_REQ Driver Circuit

2.7. TIMER Versus FORCE_ON Versus WAKEUP

L80 module uses TIMER (pin 7) signal to control an external power switch for low power operation. L86 and LC86L modules use the signal from the host (FORCE_ON/WAKEUP) to put the integrated power switch to ON position. LC86G has no pin to control power switch.

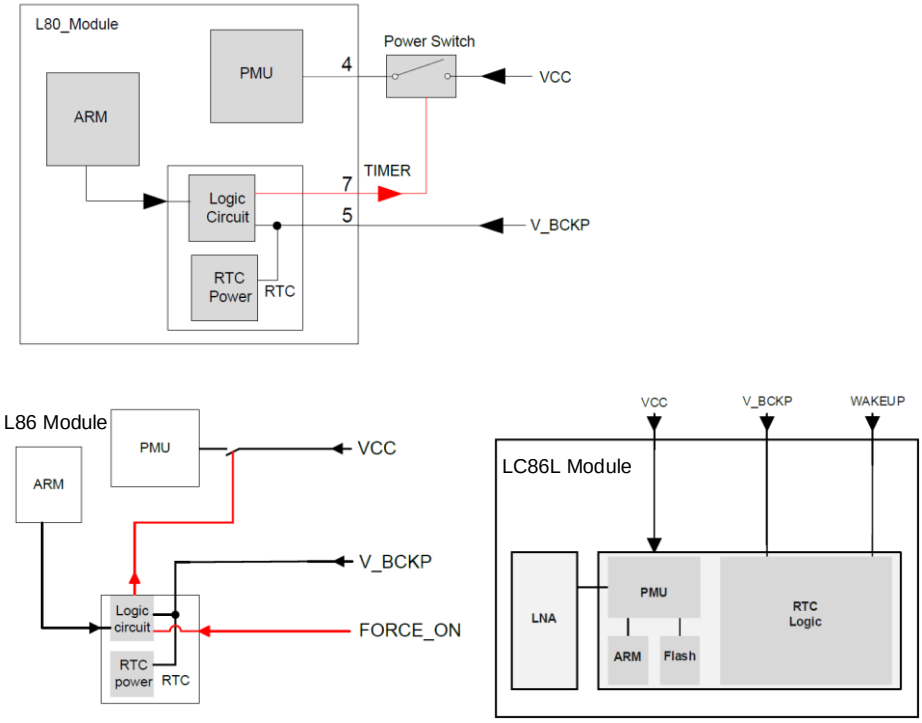


Figure 6: TIMER, FORCE_ON and WAKEUP Control Circuits

2.8. RESET_N

RESET_N is used to reset the modules from an unknown state. We have seen numerous customer designs without protection against power surges or undervoltage protection, designs not allowed for power switching, or designs with inadequate decoupling, etc. Therefore, it is strongly recommended to include the reset functionality in your design.

The reset function is implemented the same way for all modules. Inside the module, it is pulled up with a 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.**

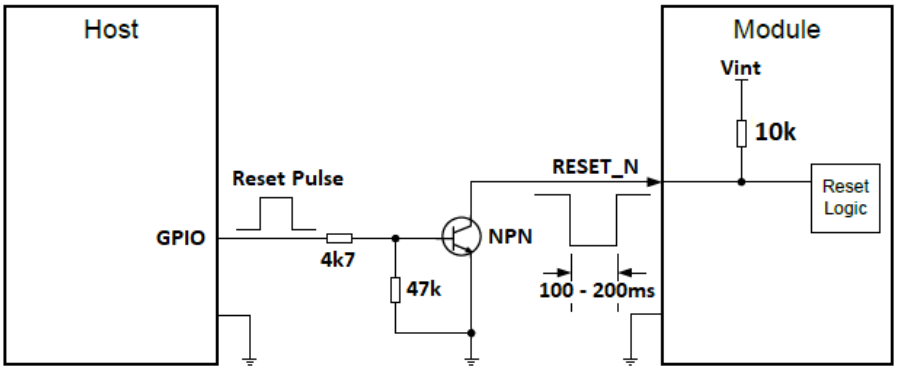


Figure 7: RESET_N Reference Circuit for All Modules

In addition, LC86G module has internal pullup on RESET_N pin which can be connected to an isolated diode. The pin can also be connected to the GPIOX of the MCU through a 0 Ω resistor. Therefore reference circuit presented in figure above is applied to all modules, whereas the circuit presented on figure below applies only to LC86G.

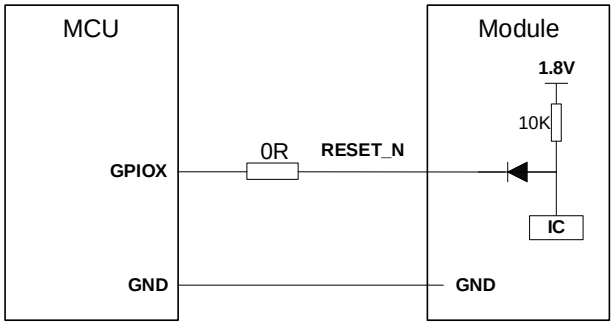
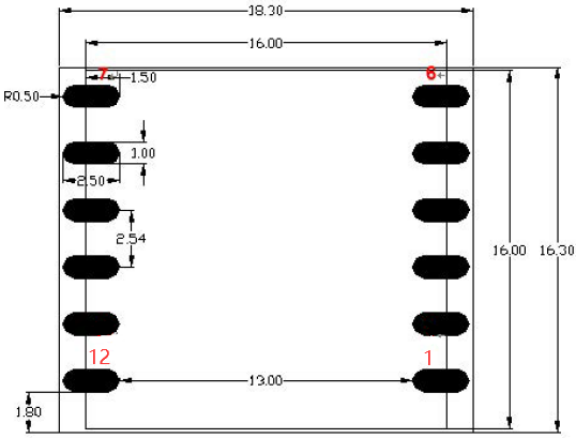
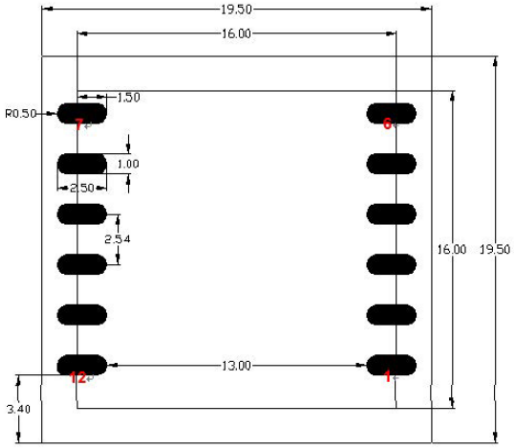


Figure 8: RESET_N Reference Circuit for LC86G

2.9. Mechanical Comparison

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

Table 5: L80, L80-R and L86 Mechanical Comparison

Mechanical Characteristics		
	L80/L80-R	**L86**
Footprint		

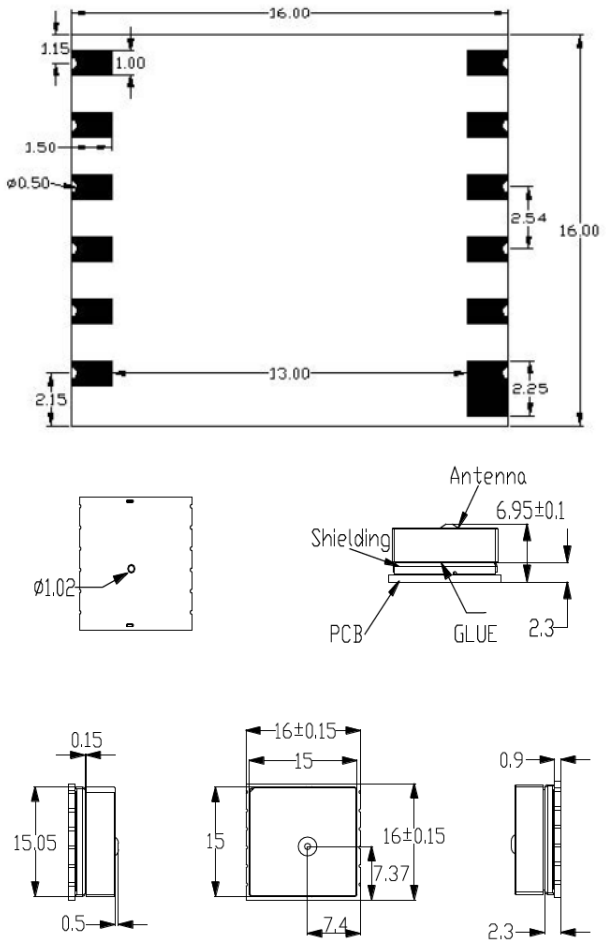
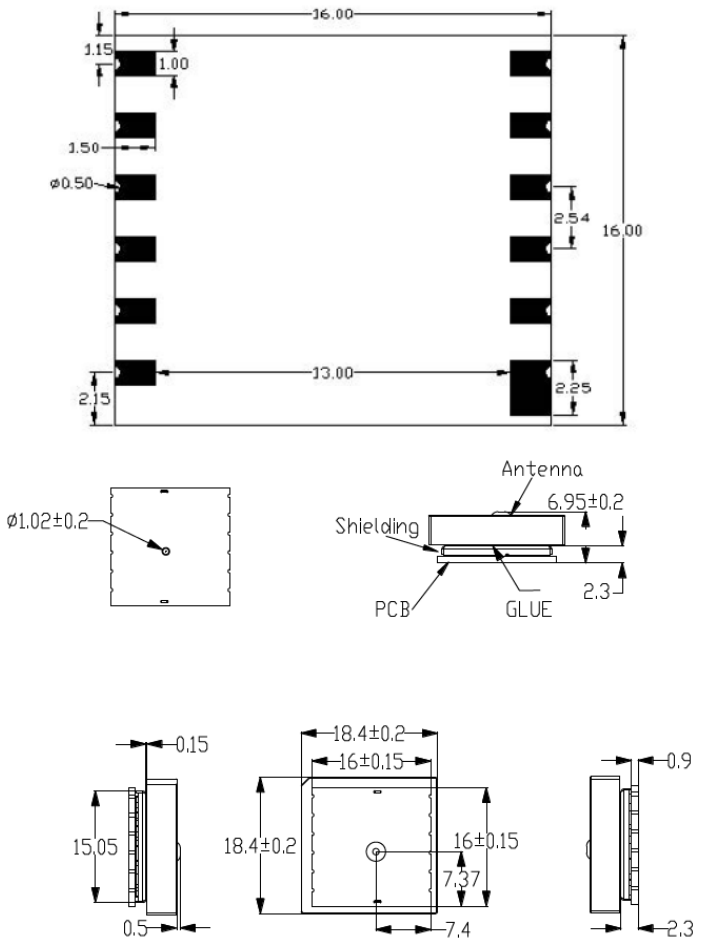
Mechanical Characteristics		
Drawing		
Length	16 mm	18.4 mm
Width	16 mm	18.4 mm
Height	6.95 mm	6.95 mm

Table 6: LC86L and LC86G Mechanical Comparison

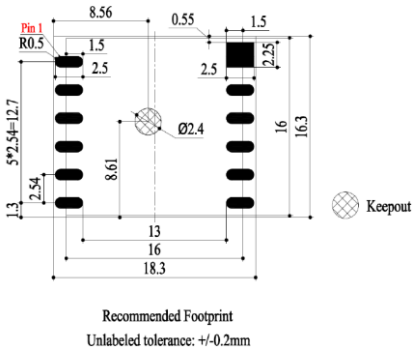
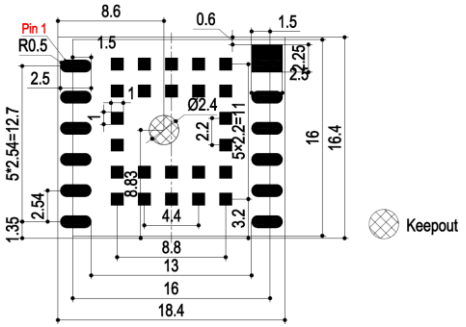
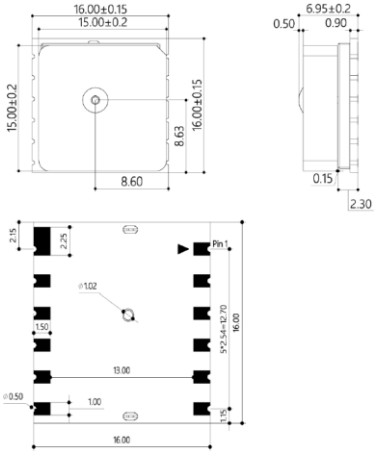
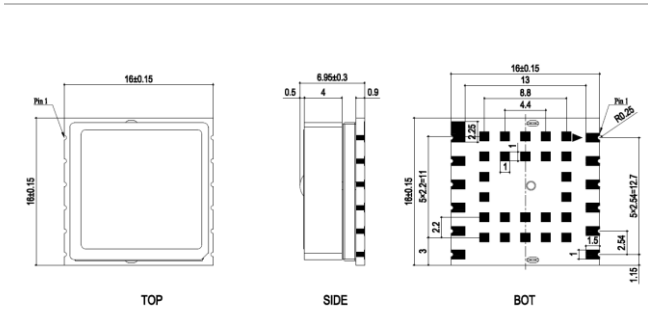
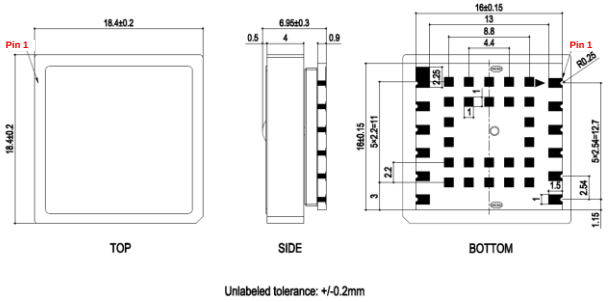
Mechanical Characteristics			
	LC86L	**LC86G (AA, AB*, LA)**	
Footprint	 Recommended Footprint Unlabeled tolerance: +/-0.2mm	 Unlabeled tolerance: +/-0.2mm	
Drawing		**LC86G (AA, AB*)**	**LC86G (LA)**
			
Length	16 mm	16 mm	18.4 mm
Width	16 mm	16 mm	18.4 mm
Height	6.95 mm	6.95 mm	6.95 mm

Table 7: Weight Specification

Module	L80/L80-R/LC86L	L86	LC86G (AA, AB*)	LC86G (LA)
Weight (g)	6.0	7.6	6.5	8.0

2.10. Electrical Compatibility

Voltage levels of L8x series and LC86x series are fully compatible. LC86G has the IO's at the power supply level, which will simplify communication circuits and reduce an LDO in the BOM.

Table 8: Voltage Tolerance Comparison

Voltage Levels [4]	L80	L80-R	L86	LC86L	LC86G
VCC	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	2–4.3 V	2–4.3 V	2–4.3 V	1.5–4.3 V	1.65–3.6 V
RESET_N [5]	-0.3–0.8 V	-0.3–0.8 V	-0.3–0.7 V	-0.3–0.7 V	-0.3–0.45 V
RXD	2.8 V	2.8 V	2.8 V	2.8 V	VCC
TXD	2.8 V	2.8 V	2.8 V	2.8 V	VCC
TXD_DBG	-	-	-	-	VCC
RXD_DBG	-	-	-	-	VCC
EX_ANT	VCC	-	VCC	VCC	-
TIMER	1.1–3.1 V	-	-	-	-
FORCE_ON/ WAKEUP	-	-	2.8 V	2.8 V	-
AP_REQ	-	-	-	-	VCC
1PPS	2.8 V	2.8 V	2.8 V	2.8 V	VCC
AADET_N	2.8 V	-	2.8 V	2.8 V	-

[4] For L80, L80-R, L86, and LC86L, the IO voltage is 2.8 V, but they could handle up to 3.1 V. Please check their hardware designs for more information about IO voltage. It's suggested to use resistors in series for all IO lines.
[5] RESET_N is internally pulled up and requires an external transistor driver.

3 Software Difference

3.1. Constellation

Table 9: Supported Constellations

System	L80	L80-R	L86	LC86L (A/B)	LC86L (C)	LC86G (LA)	LC86G (AA)	LC86G (AB)*
GPS	●	●	●	●	●	●	●	●
GLONASS	-	-	●	●	●	●	-	●
Galileo	-	-	●	-	●	●	●	●
BDS	-	-	●	●	●	●	●	-
QZSS	●	●	●	●	●	●	●	●
SBAS	●	-	●	●	●	●	●	●

Table 10: Supported Constellation Combinations

Module	Combinations
L80	● GPS ● GPS + QZSS
L80-R	● GPS ● GPS + QZSS
L86	● GPS ● GPS + QZSS ● GPS + BDS ● GPS + BDS + QZSS ● GPS + GLONASS ● GPS + GLONASS + QZSS ● GPS + GLONASS + Galileo ● GPS + GLONASS + Galileo + QZSS ● GPS + Galileo ● GPS + Galileo + QZSS

Module	Combinations
LC86L (A)	● GPS ● GPS + QZSS ● GPS + BDS ● GPS + BDS + QZSS ● GPS + GLONASS ● GPS + GLONASS + QZSS
LC86L (B)	● GPS ● GPS + QZSS ● GPS + BDS ● GPS + BDS + QZSS ● GPS + GLONASS ● GPS + GLONASS + QZSS
LC86L (C)	● GPS ● GPS + QZSS ● GPS + BDS ● GPS + BDS + QZSS ● GPS + GLONASS ● GPS + GLONASS + QZSS ● GPS + GLONASS + Galileo ● GPS + GLONASS + Galileo + QZSS ● GPS + Galileo ● GPS + Galileo + QZSS
LC86G (LA)	● GPS ● GPS + QZSS ● GPS + BDS ● GPS + BDS + QZSS ● GPS + GLONASS ● GPS + GLONASS + QZSS ● GPS + GLONASS + Galileo + BDS ● GPS + GLONASS + Galileo + BDS + QZSS ● GPS + Galileo ● GPS + Galileo + QZSS
LC86G (AA)	● GPS ● GPS + QZSS ● GPS + BDS ● GPS + BDS + QZSS ● GPS + Galileo ● GPS + Galileo + QZSS ● GPS + Galileo + BDS ● GPS + Galileo + BDS + QZSS
LC86G (AB)*	● GPS ● GPS + QZSS

Module	Combinations
	● GPS + GLONASS ● GPS + GLONASS + QZSS ● GPS + GLONASS + Galileo ● GPS + GLONASS + Galileo + QZSS ● GPS + Galileo ● GPS + Galileo + QZSS

3.2. AGNSS

Table 11: Supported AGNSS

AGNSS	L80	L80-R	L86	LC86L	LC86G
EASY	●	●	●	●	●
Flash EPO	●	-	●	●	●
Host EPO	●	●	●	●	●

3.3. NMEA Protocol Differences

3.3.1. Standard NMEA Message Differences

- L80, L86 and LC86L are compatible with NMEA V4.10 protocol.
- L80-R is compatible with NMEA V3.01 protocol.
- LC86G series is compatible with NMEA V4.11 protocol.

Table 12: Supported NMEA Messages

Message	L80	L80-R	L86	LC86L	LC86G
RMC	●	●	●	●	●
GGA	●	●	●	●	●
GSV	●	●	●	●	●
GSA	●	●	●	●	●

Message	L80	L80-R	L86	LC86L	LC86G
VTG	●	●	●	●	●
GLL	●	●	●	●	●
TXT	●	-	●	●	-
GBS	-	-	●	●	-
DTM	●	-	●	●	-

NOTE

The modules support the same NMEA sentence format.

Table 13: 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

On L80 and L80-R, the Talker ID is always **GP**.

On L86, the Talker ID of position fixed is shown in the table below. The Talker ID is always **GP** if the position is not fixed.

Table 14: Talker ID of Position Fixed for L86

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

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

NOTE

The current Talker ID of QZSS on LC86G is still **GP**. On the subsequent version, **GP** will be changed to **GQ**. Contact Quectel Technical Support (support@quectel.com) for more details.

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
$	character	-
<TalkerID>	String, 2 characters	-
RMC	String, 3 characters	-
<UTC>	hhmmss.sss	-
<Status>	Character	-
<Lat>	ddmm.mmmmmm	L80, L80-R, and L86: Default length of minute decimal fraction is 4 digits. LC86L and LC86G series: Default length of minute decimal fraction is 6 digits.

Field	Format	Note
<N/S>	Character	-
<Lon>	dddmm.mmmmmm	L80, L80-R, and L86: Default length of minute decimal fraction is 4 digits. LC86L and LC86G series: Default length of minute decimal fraction is 6 digits.
<E/W>	Character	-
<SOG>	Numeric	-
<COG>	Numeric	-
<Date>	ddmmyy	-
<MagVar>	-	-
<MagVarDir>	-	-
<ModeInd>	Character	-
<NavStatus>	Character	L80-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
$	character	-

Field	Format	Note
<TalkerID>	String, 2 characters	-
GGA	String, 3 characters	-
<UTC>	hhmmss.sss	-
<Lat>	ddmm.mmmmmm	L80, L80-R, and L86: Default length of minute decimal fraction is 4 digits. LC86L and LC86G series: Default length of minute decimal fraction is 6 digits.
<N/S>	Character	-
<Lon>	dddmm.mmmmmm	L80, L80-R, and L86: Default length of minute decimal fraction is 4 digits. LC86L and LC86G series: Default length of minute decimal fraction is 6 digits.
<E/W>	Character	-
<Quality>	Numeric, 1 digit	-
<NumSatUsed>[1)]	Numeric, 2 digits	-
<HDOP>	Numeric	-
<Alt>	Numeric	L80, L80-R, and L86: Default length of decimal fraction is 1 digit. LC86L and LC86G series: Default length of decimal fraction is 3 digits.
M	Character	-
<Sep>	Numeric	L80, L80-R, and L86: Default length of decimal fraction is 1 digit. LC86L and LC86G series: 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
$	character	-
<TalkerID>	String, 2 characters	-
GSV	String, 3 characters	-
<TotalNumSen>	Numeric	L80-R: Number of messages. Range: 1–3. L80, L86, LC86L, and LC86G series: Number of messages. Range: 1–9.
<SenNum>	Numeric	-
<TotalNumSat>	Numeric	-
Start of repeat block. Repeat times: 1–4.		
<SatID>	Numeric	-

Field	Format	Note
<SatElev>	Numeric	-
<SatAz>	Numeric	-
<SatCN0>	Numeric	-
End of repeat block.		
<SignalID>	Numeric	L80-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
$	character	-
<TalkerID>	String, 2 characters	L80 and L80-R: Always “GP”. L86, LC86L, and LC86G series: See *Table 13: Difference on NMEA Talker ID*
GSA	String, 3 characters	-

Field	Format	Note
<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	L80-R: This field does not exist.
<Checksum>	Hexadecimal	-
<CR><LF>	Character	-

NOTE

1. L80, L80-R, L86, LC86L: 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. LC86G series: None of the above restrictions apply.

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
$	character	-
<TalkerID>	String, 2 characters	-
VTG	String, 3 characters	-
<COGT>	Numeric	L80-R: Default length of minute decimal fraction is 1 digit. L80, L86, LC86Land LC86G series: Default length of minute decimal fraction is 2 digits.
T	Character	-
<COGM>	Numeric	-
M	Character	-
<SOGN>	Numeric	L80-R: Default length of minute decimal fraction is 1 digit. L80, L86, LC86L, and LC86G series: Default length of minute decimal fraction is 2 digits.
N	Character	-
<SOGK>	Numeric	L80-R: Default length of minute decimal fraction is 1 digit. L80, L86, LC86L, and LC86G series: Default length of minute 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
$	character	-
<TalkerID>	String, 2 characters	-
GLL	String, 3 characters	-
<Lat>	ddmm.mmmmmm	L80, L86, and L80-R: Default length of minute decimal fraction is 4 digits. LC86L and LC86G series: Default length of minute decimal fraction is 6 digits.
<N/S>	Character	-
<Lon>	dddmm.mmmmmm	L80, L86, and L80-R: Default length of minute decimal fraction is 4 digits. LC86L and LC86G series: Default length of minute decimal fraction is 6 digits.
<E/W>	Character	-
<UTC>	hhmmss.sss	-
<Status>	Character	-
<ModeInd>	Character	-
<Checksum>	Hexadecimal	-
<CR><LF>	Character	-

3.3.2. PMTK Versus PAIR Messages

PMTK messages are supported by Quectel L80, L80-R, L86, and LC86L.

PAIR messages are supported by LC86G series.

Table 15: Differences between PMTK and PAIR Messages

L80	L80-R	L86	LC86L	LC86G	Description
PMTK001	PMTK001	PMTK001	PMTK001	PAIR001	Acknowledges message.
-	-	-	-	PAIR002	Powers on the GNSS system.
-	-	-	-	PAIR003	Powers off the GNSS system.
PMTK161	PMTK161	PMTK161	PMTK161	-	Enables/disables Standby mode.
PMTK011	PMTK011	PMTK011	PMTK011	-	Automatically outputs text message when the modules are powered up.
PMTK101	PMTK101	PMTK101	PMTK101	PAIR004	Performs a hot start.
PMTK102	PMTK102	PMTK102	PMTK102	PAIR005	Performs a warm start.
PMTK103	PMTK103	PMTK103	PMTK103	PAIR006	Performs a cold start.
PMTK104	PMTK104	PMTK104	PMTK104	PAIR007	Performs a cold start and clears system and user configurations at the start.
PMTK010	PMTK010	PMTK010	PMTK010	PAIR010	Notifies the expiration of GNSS aiding data stored on the module.
PMTK220	PMTK220	PMTK220	PMTK220	PAIR050	Sets position fix interval.
-	PMTK500 PMTK400	-	-	PAIR051	Gets the position fix interval.
-	-	PMTK306	PMTK306	PAIR058	Sets the minimum SNR of satellites in use.
-	-	-	-	PAIR059	Gets the minimum SNR of satellites in use.
PMTK314	PMTK314	PMTK314	PMTK314	PAIR062	Sets the output rate of standard NMEA sentence.
PMTK414 PMTK514	PMTK414 PMTK514	PMTK414 PMTK514	PMTK414 PMTK514	PAIR063	Gets the output rate of standard NMEA sentence.
PMTK351 PMTK352	-	PMTK351 PMTK352 PMTK353	PQTM351 PMTK352 PMTK353	PAIR066	Sets the GNSS search mode.

L80	L80-R	L86	LC86L	LC86G	Description
-	-	-	-	PAIR067	Gets the GNSS search mode.
PMTK386	PMTK386	PMTK386	PMTK386	PAIR070	Sets the static navigation speed threshold.
-	-	-	-	PAIR071	Gets the static navigation speed threshold.
-	-	PMTK311	PMTK311	PAIR072	Sets satellite elevation mask.
-	-	-	-	PAIR073	Gets satellite elevation mask.
PMTK286	PMTK286	PMTK286	PMTK286	PAIR074	Enables/disables AIC function.
-	-	-	-	PAIR075	Queries AIC function.
PMTK886	PMTK886	PMTK886	PMTK886	PAIR080	Sets navigation mode.
-	-	-	-	PAIR081	Queries navigation mode.
-	-	-	-	PAIR086	Enables/disables debug log output in binary format.
-	-	-	-	PAIR087	Queries the debug log output setting.
-	-	-	-	PAIR382	Enables/disables system sleep status locking.
PMTK838	-	-	-	PAIR391	Enables/disables jamming detection.
PMTK301	PMTK301	PMTK301	PMTK301	PAIR400	Sets the source mode of DGPS correction data.
PMTK401 PMTK501	PMTK401 PMTK501	PMTK401 PMTK501	PMTK401 PMTK501	PAIR401	Queries the setting of DGPS mode.
PMTK313	-	PMTK313	PMTK313	PAIR410	Enables/disables the searching of SBAS satellites.
PMTK413 PMTK513	-	PMTK413 PMTK513	PMTK413 PMTK513	PAIR411	Queries the status of SBAS satellite search.
-	-	-	-	PAIR432	Sets RTCM output mode.
-	-	-	-	PAIR433	Queries RTCM output mode.
PMTK869	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.

L80	L80-R	L86	LC86L	LC86G	Description
-	-	-	-	PAIR513	Saves the current configurations from RTC RAM to flash.
PMTK225	-	PMTK225	PMTK225	PAIR650	Puts the module to Backup mode.
PMTK285	PMTK285	PMTK285	PMTK285	PAIR752	Sets PPS configurations.
-	-	-	-	PAIR864	Sets the baud rate of UART interface.
-	-	-	-	PAIR865	Gets the baud rate of UART interface.
-	-	-	-	PAIR890	Sets geofence configuration.
-	-	-	-	PAIR891	Queries the GEOFENCE configuration.
-	-	-	-	PAIR892	Sets GPIO polarity for GEOFENCE combined state.
PMTK183	-	PMTK183	PMTK183	-	Queries the LOCUS logging status.
PMTK184	-	PMTK184	PMTK184	-	Erases the LOCUS logger flash data.
PMTK185	-	PMTK185	PMTK185	-	Stops or starts LOCUS data logging.
PMTK225	-	PMTK225	PMTK225	-	Sets the modules to Periodic mode for power saving.

3.3.3. PQ Messages

PQ messages are supported by Quectel L80, L86, and LC86L.

Table 16: PQ Message Matching

L80	L86	LC86L	LC86G	Description
PQBAUD	PQBAUD	PQBAUD	PAIR864	Sets NMEA port default baud rate.
PQEPE	PQEPE	PQEPE	-	Enables/disables PQEPE message outputting.
PQ1PPS	PQ1PPS	PQ1PPS	PAIR752	Sets the type and pulse width of 1PPS output.
PQFLP	-	-	-	Sets the modules to FLP mode and gets module operation mode.
PQTXT	PQTXT	PQTXT	-	Enables/disables GPTXT message outputting.
PQECEF	PQECEF	PQECEF	-	Enables/disables ECEFPOSVEL message outputting.
ECEFPOSVEL	ECEFPOSVEL	ECEFPOSVEL	-	This message is automatically output when PQECEF is enabled.
PQODO	PQODO	PQODO	-	Starts/stops odometer reading.
PQPZ90	PQPZ90	PQPZ90	-	Enables/disables switching from WGS84 to PZ-90.11.
-	PQGLP	PQGLP	-	Sets the modules to GLP mode and gets whether the GLP mode is enabled.
PQVEL	PQVEL	PQVEL	-	Enables/disables PQVEL message outputting.
PQJAM	PQJAM	PQJAM	PAIR391	Enables/disables jamming detection function.
-	PQRLM	PQRLM	-	Enables/disables the return link message outputting.
PQGEO	PQGEO	PQGEO	PAIR890	Configures Geo-fence parameters.
-	PQPREC	PQPREC	PAIR098	Configures parameters (latitude/longitude/altitude) in NMEA sentences by setting the number of digits after the decimal point.
-	PQGBS	PQGBS	-	Enables/disables the outputting of the GBS sentence used to support receiver autonomous integrity monitoring (RAIM).
PQVERNO	PQVERNO	PQVERNO	PQTMVERNO	Queries the information about firmware version.

NOTE

Among LC86L (A), LC86L (B) and LC86L (C), only LC86L (C) supports **PQRLM**.

4 Appendix A References

Table 17: Related Documents

Document Name
[1] Quectel_L80_Hardware_Design
[2] Quectel_L80-R_Hardware_Design
[3] Quectel_L86_Hardware_Design
[4] Quectel_LC86L_Hardware_Design
[5] Quectel_LC86G_Series_Hardware_Deisgn
[6] Quectel_L80&L86&LC86L_Reference_Design
[7] Quectel_L80-R_Series_Reference_Design
[8] Quectel_LC86G_Series_Reference_Design
[9] Quectel_Lx0&Lx6&LC86L&LG77L_GNSS_Protocol_Specification
[10] Quectel_L80-R_GPS_Protocol_Specification
[11] Quectel_LC26G&LC76G&LC86G_Series_GNSS_Protocol_Specification

Table 18: 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

Abbreviation	Description
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
DTM	Datum Reference
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)
GBS	GNSS Satellite Fault Detection
GGA	Global Positioning System Fix Data
GLL	Geographic Position - Latitude and Longitude
GLONASS	Global Navigation Satellite System (Russia)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GSA	GNSS DOP and Active Satellites
GSV	GNSS Satellites in View
HDOP	Horizontal Dilution of Precision
IO	Input/Output
LDO	Low-dropout Regulator
LNA	Low-Noise Amplifier
MSAS	Multi-functional Satellite Augmentation System (Japan)
NMEA	NMEA (National Marine Electronics Association) 0183 Interface Standard

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

5 Appendix B GNSS Numbering

Table 19: 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	7 = E1
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 LC86G and may vary depending on modules. For more information, see GNSS protocol specification document for the dedicated module.