NEO-M8

u-blox M8 concurrent GNSS modules

Data Sheet

Highlights:

- Concurrent reception of GPS/QZSS, GLONASS, BeiDou
- Industry leading −167 dBm navigation sensitivity
- Product variants to meet performance and cost requirements
- Combines low power consumption and high sensitivity
- Backward compatible with NEO-7, NEO-6 and NEO-5 families

u-blox

Document Information

Title	**NEO-M8**
Subtitle	u-blox M8 concurrent GNSS modules
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Document status explanation	
Objective Specification	Document contains target values. Revised and supplementary data will be published later.
Advance Information	Document contains data based on early testing. Revised and supplementary data will be published later.
Early Production Information	Document contains data from product verification. Revised and supplementary data may be published later.
Production Information	Document contains the final product specification.

This document applies to the following products:

Product name	Type number	ROM/FLASH version	PCN reference
NEO-M8N	NEO-M8N-0-01	ROM 2.01/Flash FW 2.01	N/A
NEO-M8M	NEO-M8M-0-01	ROM 2.01	UBX-15015253
NEO-M8Q	NEO-M8Q-0-01	ROM 2.01	UBX-15015253

Contents

1 Functional description

1.1 Overview

The NEO-M8 series of standalone concurrent GNSS modules is built on the exceptional performance of the u-blox M8 GNSS (GPS, GLONASS, BeiDou, QZSS, SBAS and Galileo-ready[1]) engine in the industry proven NEO form factor.

The NEO-M8 series provides high sensitivity and minimal acquisition times while maintaining low system power. The NEO-M8M is optimized for cost sensitive applications, while NEO-M8N/M8Q provides best performance and easier RF integration. The NEO form factor allows easy migration from previous NEO generations. Sophisticated RF-architecture and interference suppression ensure maximum performance even in GNSS-hostile environments.

The NEO-M8 series combines a high level of robustness and integration capability with flexible connectivity options. The future-proof NEO-M8N includes an internal Flash that allows simple firmware upgrades for supporting additional GNSS systems. This makes NEO-M8 perfectly suited to industrial and automotive applications.

The DDC (I^2C compatible) interface provides connectivity and enables synergies with most u-blox cellular modules. For RF optimization the NEO-M8N/M8Q features an additional front-end LNA for easier antenna integration and a front-end SAW filter for increased jamming immunity.

u-blox M8 modules use GNSS chips qualified according to AEC-Q100, are manufactured in ISO/TS 16949 certified sites, and fully tested on a system level. Qualification tests are performed as stipulated in the ISO16750 standard: "Road vehicles – Environmental conditions and testing for electrical and electronic equipment".

u-blox' AssistNow Assistance supply aiding information, such as ephemeris, almanac, rough last position and time, reduce the time to first fix significantly and improve the acquisition sensitivity. AssistNow data are with u-blox M8 supporting both GPS and GLONASS constellation for faster acquisition than a GPS-only assistance. The extended validity of AssistNow Offline data (up to 35 days) and AssistNow Autonomous data (up to 6 days) provide faster acquisition after long off time.

☞ See section **Error! Reference source not found.** for more information concerning the NEO-M8 series related AssistNow Assistance.

1.2 Product features

Model	Type								Supply			Interfaces				Features											Grade		
	GPS / QZSS	GLONASS	Galileo	BeiDou	Timing	Dead Reckoning	Precise Point Positioning	Raw Data	1.65 V – 3.6 V	2.7 V – 3.6 V	Lowest power (DC/DC)	UART	USB	SPI	DDC (I²C compliant)	Programmable (Flash)	Data logging	Additional SAW	Additional LNA	RTC crystal	Internal oscillator	Active antenna / LNA supply	Active antenna / LNA control	Antenna short circuit detection / protection pin	Antenna open circuit detection pin	Frequency output	Standard	Professional	Automotive
NEO-M8N	•	•	R	•						•	•	•	•	•	•	•	•	•	•	•	T	o	•					Professional	
NEO-M8Q	•	•		•						•	•	•	•	•	•			•	•	•	T	o	•					Professional	
NEO-M8M	•	•		•						•		•	•	•	•					•	C	o						Professional	

o = Optional, not activated per default or requires external components
C = Crystal / T = TCXO
R = Galileo ready

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[1] with future flash firmware update

1.3 Performance

Parameter	Specification			
Receiver type	72-channel u-blox M8 engine GPS L1C/A SBAS L1C/A QZSS L1C/A GLONASS L1OF BeiDou B1 Galileo E1B/C[2]			
NEO-M8N/Q	**GNSS**	**GPS & GLONASS**	**GPS & BeiDou**	**GPS**
Time-To-First-Fix [3]	Cold start	26 s	27 s	29 s
	Hot start	1 s	1 s	1 s
	Aided starts [4]	2 s	3 s [5]	2 s
Sensitivity [6]	Tracking & Navigation	−167 dBm	−165 dBm	−166 dBm
	Reacquisition	−160 dBm	−160 dBm	−160 dBm
	Cold start	−148 dBm	−148 dBm	−148 dBm
	Hot start	−156 dBm	−156 dBm	−156 dBm
NEO-M8M	**GNSS**	**GPS & GLONASS**	**GPS & BeiDou**	**GPS**
Time-To-First-Fix [3]	Cold start	27 s	28 s	30 s
	Hot start	1 s	1 s	1 s
	Aided starts [4]	4 s	6 s [5]	3 s
Sensitivity [6]	Tracking & Navigation	−164 dBm	−162 dBm	−163 dBm
	Reacquisition	−159 dBm	−159 dBm	−159 dBm
	Cold start	−147 dBm	−147 dBm	−147 dBm
	Hot start	−156 dBm	−156 dBm	−156 dBm
TCXO or Crystal	**GNSS**	**GPS & GLONASS**	**GPS & BeiDou**	**GPS**
Max navigation update rate	NEO-M8N NEO-M8M/Q	5 Hz 10 Hz	5 Hz 10 Hz	10 Hz 18 Hz
Velocity accuracy [7]		0.05 m/s		
Heading accuracy [7]		0.3 degrees		
Horizontal position accuracy [8]	Autonomous SBAS	2.5 m 2.0 m		
Accuracy of time pulse signal	RMS 99%	30 ns 60 ns		
Frequency of time pulse signal		0.25 Hz…10 MHz (configurable)		
Operational limits [9]	Dynamics	≤ 4 g		
	Altitude	50,000 m		
	Velocity	500 m/s		

Table 1: NEO-M8 performance in different GNSS modes (default: concurrent reception of GPS and GLONASS)

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[2] Ready to support Galileo E1B/C when available (NEO-M8N)
[3] All satellites at -130 dBm
[4] Dependent on aiding data connection speed and latency
[5] BeiDou assisted acquisition is not available with FW 2.01
[6] Demonstrated with a good external LNA
[7] 50% @ 30 m/s
[8] CEP, 50%, 24 hours static, -130 dBm, > 6 SVs
[9] Assuming Airborne < 4 g platform
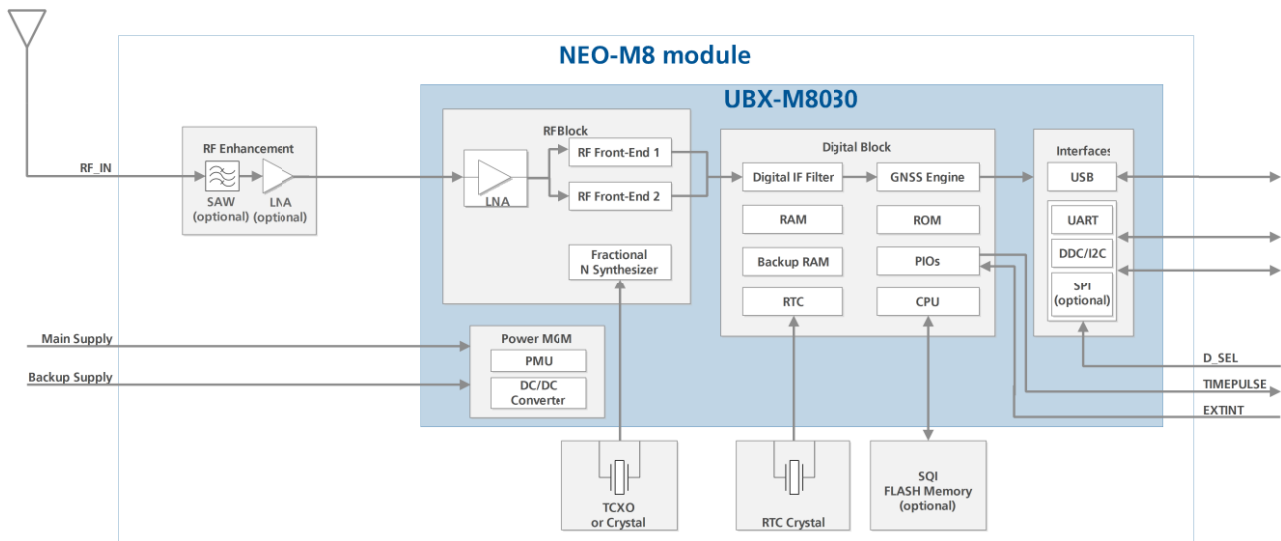
1.4 Block diagram

Figure 1: NEO-M8 block diagram

1.5 GNSS

The NEO-M8 GNSS modules are concurrent GNSS receivers and can receive and track multiple GNSS systems (e.g. GPS, GLONASS, Galileo-ready, BeiDou and QZSS signals). Because of the dual-frequency RF front-end architecture, two of the three signals (GPS L1C/A, GLONASS L1OF and BeiDou B1) can be received and processed concurrently. By default the M8 receivers are configured for concurrent GPS (includes SBAS and QZSS) and GLONASS reception. If power consumption is a key factor, then the receiver should be configured for single GNSS operation using either GPS or GLONASS or BeiDou and disabling QZSS and SBAS.

☞ Galileo, QZSS and SBAS share the same frequency band as GPS and can always be processed in conjunction with GPS.

1.5.1 GPS

The NEO-M8 positioning modules are designed to receive and track the L1C/A signals provided at 1575.42 MHz by the Global Positioning System (GPS). The NEO-M8 series can receive and process GPS concurrently with GLONASS or BeiDou.

1.5.2 GLONASS

The NEO-M8 modules can receive and process GLONASS concurrently with GPS or BeiDou. The Russian GLONASS satellite system is an alternative system to the US-based Global Positioning System (GPS). u-blox NEO-M8 positioning modules are designed to receive and track the L1OF signals GLONASS provides at 1602 MHz + k*562.5 kHz, where k is the satellite's frequency channel number (k = −7,..., 5, 6). The ability to receive and track GLONASS L1OF satellite signals allows design of GLONASS receivers where required by regulations.

To take advantage of GPS and GLONASS, dedicated hardware preparation must be made during the design-in phase. See the NEO-M8 Hardware Integration Manual [1] for u-blox design recommendations.

1.5.3 BeiDou

The NEO-M8 modules can receive and process BeiDou concurrently with GPS or GLONASS. u-blox NEO-M8 positioning modules are designed to receive and track the B1 signals provided at 1561.098 MHz by the BeiDou Navigation Satellite System. The ability to receive and track BeiDou B1 satellite signals in conjunction with GPS results in higher coverage, improved reliability and better accuracy. By the end of 2013 BeiDou is not fully operational and provides regional coverage only. Global coverage is scheduled for 2020.

1.5.4 Galileo

The NEO-M8N positioning module is ready to receive and track GPS and Galileo signals concurrently, enhancing accuracy and coverage. When Galileo E1B/C signals become available, u-blox NEO-M8N receiver equipped with an SQI flash memory device will be capable of receiving and processing them via a firmware update.

1.5.5 QZSS

The Quasi-Zenith Satellite System (QZSS) is a regional navigation satellite system that transmits additional GPS L1C/A signals for the Pacific region covering Japan and Australia. NEO-M8 series positioning modules are able to receive and track these signals concurrently with GPS signals, resulting in better availability especially under bad signal conditions, e.g. in urban canyons. The L1-SAIF signal provided by QZSS is not supported.

1.6 Assisted GNSS (A-GNSS)

Supply of aiding information, such as ephemeris, almanac, rough last position and time, will reduce the time to first fix significantly and improve the acquisition sensitivity. All u-blox M8 products support the u-blox AssistNow Online and AssistNow Offline A-GNSS services, support AssistNow Autonomous, and are OMA SUPL compliant.

1.6.1 AssistNow™ Online

With AssistNow Online, an internet-connected GNSS device downloads assistance data from u-blox' AssistNow Online Service at system start-up. AssistNow Online is network-operator independent and globally available. u-blox only sends ephemeris data for those satellites currently visible to the device requesting the data, thus minimizing the amount of data transferred.

Supply of aiding information, such as ephemeris, almanac, rough last position and time, will reduce the time to first fix significantly and improve the acquisition sensitivity.

1.6.2 AssistNow™ Offline

With AssistNow Offline, users download u-blox' long-term orbit data from the Internet at their convenience. The orbit data can be stored in the GNSS receiver's SQI flash memory (NEO-M8N) or must be stored in the memory of the application processor (NEO-M8M/M8Q). Thus the service requires no connectivity at system start-up, enabling a position fix within seconds, even when no network is available. AssistNow Offline offers augmentation for up to 35 days.

1.6.3 AssistNow™ Autonomous

AssistNow Autonomous provides aiding information without the need for a host or external network connection. Based on previous broadcast satellite ephemeris data downloaded to and stored by the GNSS receiver, AssistNow Autonomous automatically generates accurate satellite orbital data ("AssistNow Autonomous data") that is usable for future GNSS position fixes. The concept capitalizes on the periodic nature of GNSS satellites: their position in the sky is basically repeated every 24 hours. By capturing strategic ephemeris data at specific times of the day, the receiver can predict accurate satellite ephemeris for up to six days after initial reception. If using AssistNow Autonomous, the use of NEO-M8N (with SQI flash memory) is highly recommended.

u-blox' AssistNow Autonomous benefits are:
- Faster fix in situations where GNSS satellite signals are weak
- No connectivity required
- Compatible with AssistNow Online and Offline (can work stand-alone, or in tandem with these services)
- No integration effort; calculations are done in the background, transparent to the user.

☞ For ROM-based NEO-M8M/M8Q receivers, AssistNow Autonomous can calculate GPS only orbit predictions for up to 6 days (3 days by defaults).

☞ For more details see the u-blox M8 Receiver Description Including Protocol Specification [2].

1.7   Augmentation Systems

1.7.1 Satellite-Based Augmentation System (SBAS)

The u-blox M8 positioning modules support SBAS. These systems supplement GPS data with additional regional or wide area GPS augmentation data. The system broadcasts augmentation data via satellite and this information can be used by GNSS receivers to improve the resulting precision. SBAS satellites can be used as additional satellites for ranging (navigation), further enhancing precision and availability. The following SBAS types are supported with u-blox M8: WAAS, EGNOS and MSAS.

☞   For more details see the u-blox M8 Receiver Description Including Protocol Specification [2].

1.7.2 Differential GPS (D-GPS)

u-blox M8 receivers support Differential-GPS data according RTCM 10402.3: "RECOMMENDED STANDARDS FOR DIFFERENTIAL GNSS". The use of Differential-GPS data improves GPS position accuracy. RTCM cannot be used together with SBAS. The RTCM implementation supports the following RTCM 2.3 messages:

Message Type	Description
1	Differential GPS Corrections
2	Delta Differential GPS Corrections
3	GPS Reference Station Parameters
9	GPS Partial Correction Set

Table 2: Supported RTCM 2.3 messages

☞   For more details see the u-blox M8 Receiver Description Including Protocol Specification [2].

1.8   Odometer

The odometer provides information on travelled ground distance (in meter) using solely the position and Doppler-based velocity of the navigation solution. For each computed travelled distance since the last odometer reset, the odometer estimates a 1-sigma accuracy value. The total cumulative ground distance is maintained and saved in the BBR memory.

☞   The odometer feature is disabled by default. For more details see the u-blox M8 Receiver Description Including Protocol Specification [2].

1.9   Data logging (NEO-M8N)

The u-blox NEO-M8N receiver can be used in data logging applications. The data logging feature enables continuous storage of position, velocity and time information to an onboard SQI flash memory (at least 16 Mbit). It can also log the distance from the odometer. The information can be downloaded from the receiver later for further analysis or for conversion to a mapping tool. For more information see the u-blox M8 Receiver Description Including Protocol Specification [2].

1.10 EXTINT: External interrupt

EXTINT is an external interrupt pin with fixed input voltage thresholds with respect to VCC. It can be used for control of the receiver or for aiding.

For more information about how to implement and configure these features, see the u-blox M8 Receiver Description including Protocol Specification [2] and the NEO-M8 Hardware Integration Manual [1].

1.10.1 Pin Control

The pin control feature allows overriding the automatic active/inactive cycle of Power Save Mode. The state of the receiver can be controlled through the EXTINT pin.

The receiver can also be forced OFF using EXTINT when Power Save Mode is not active.

1.10.2 Aiding

The EXTINT pin can be used to supply time or frequency aiding data to the receiver.

For time aiding, hardware time synchronization can be achieved by connecting an accurate time pulse to the EXTINT pin.

Frequency aiding can be implemented by connecting a periodic rectangular signal with a frequency up to 500 kHz and arbitrary duty cycle (low/high phase duration must not be shorter than 50 ns) to the EXTINT pin. Provide the applied frequency value to the receiver using UBX messages.

1.11 TIMEPULSE

A configurable time pulse signal is available with all u-blox M8 modules.

The TIMEPULSE output generates pulse trains synchronized with GPS or UTC time grid with intervals configurable over a wide frequency range. Thus it may be used as a low frequency time synchronization pulse or as a high frequency reference signal.

By default the time pulse signal is configured to 1 pulse per second. For more information see the u-blox M8 Receiver Description including Protocol Specification [2].

1.12 Protocols and interfaces

Protocol	Type
NMEA 0183, version 4.0 (V2.3 or V4.1 configurable)	Input/output, ASCII
UBX	Input/output, binary, u-blox proprietary
RTCM	Input message, 1, 2, 3, 9

Table 3: Available Protocols

All protocols are available on UART, USB, DDC (I^2C compliant) and SPI. For specification of the various protocols see the u-blox M8 Receiver Description Including Protocol Specification [2].

1.13 Interfaces

A number of interfaces are provided either for data communication or memory access. The embedded firmware uses these interfaces according to their respective protocol specifications.

1.13.1 UART

The NEO-M8 series modules include one UART interface, which can be used for communication to a host. It supports configurable baud rates. For supported baud rates see the u-blox M8 Receiver Description Including Protocol Specification [2].

☞ Designs must allow access to the UART and the **SAFEBOOT_N** function pin for future service, updates and reconfiguration.

1.13.2 USB

A USB version 2.0 FS compatible interface can be used for communication as an alternative to the UART. The pull-up resistor on pin USB_DP is integrated to signal a full-speed device to the host. The VDD_USB pin supplies the USB interface.

u-blox USB (CDC-ACM) driver supports Windows Vista and Windows 7 and Windows 8 operating systems.

1.13.3 SPI

The SPI interface is designed to allow communication to a host CPU. The interface can be operated in slave mode only. The maximum transfer rate using SPI is 1 Mb/s and the maximum SPI clock frequency is 5.5 MHz. Note that SPI is not available in the default configuration, because its pins are shared with the UART and DDC interfaces. The SPI interface can be enabled by connecting D_SEL (Pin 2) to ground (see section 3.1).

1.13.4 Display Data Channel (DDC)

An I^{2}C compliant DDC interface is available for communication with an external host CPU or u-blox cellular modules. The interface can be operated in slave mode only. The DDC protocol and electrical interface are fully compatible with Fast-Mode of the I^{2}C industry standard. Since the maximum SCL clock frequency is 400 kHz, the maximum transfer rate is 400 kb/s.

1.14 Clock generation

1.14.1 Oscillators

NEO-M8 GNSS modules are available in TCXO and crystal versions. The TCXO allows accelerated weak signal acquisition, enabling faster start and reacquisition times.

Oscillators used on NEO-M8 module are carefully selected and screened for stability and against frequency perturbations across the full operating range (–40° to +85°C).

The careful selection and qualification of critical parts, such as GNSS oscillators, has resulted in u-blox modules being the most reliable positioning modules in the industry, particularly in challenging conditions.

1.14.2 Real-Time Clock (RTC)

The RTC is driven by a 32 kHz oscillator using an RTC crystal. If the main supply voltage fails, and a battery is connected to V_BCKP, parts of the receiver switch off, but the RTC still runs providing a timing reference for the receiver. This operating mode is called Hardware Backup Mode, which enables all relevant data to be saved in the backup RAM to allow a hot or warm start later.

1.15 Power management

u-blox M8 technology offers a power-optimized architecture with built-in autonomous power saving functions to minimize power consumption at any given time. Furthermore, the receiver can be used in two operating modes: Continuous mode for best performance or Power Save Mode for optimized power consumption respectively. In addition, a high efficiency DC/DC converter is integrated to allow low power consumption even for higher main supply voltages.

1.15.1 DC/DC converter

NEO-M8 series modules integrate a DC/DC converter, allowing reduced power consumption especially when using a main supply voltage above 2.5 V.

☞   For more information see the NEO-M8 Hardware Integration Manual [1]

1.15.2 Operating modes

u-blox M8 modules have two operating modes:

* Continuous Mode for best GNSS performance
* Power Save Mode to optimize power consumption

1.15.2.1 Continuous Mode

Continuous Mode uses the acquisition engine at full performance resulting in the shortest possible TTFF and the highest sensitivity. It searches for all possible satellites until the Almanac is completely downloaded. The receiver then switches to the tracking engine to lower power consumption.

Thus, a lower tracking current consumption level will be achieved when:

* A valid GNSS position is obtained
* The entire Almanac has been downloaded
* The Ephemeris for each satellite in view is valid

1.15.2.2 Power Save Mode

For power sensitive applications, u-blox M8 receivers provide a Power Save Mode for reduced power consumption.

Power Save Mode provides two dedicated methods, ON/OFF and Cyclic tracking, that reduce average current consumption in different ways to match the needs of the specific application. These operations can be set by using a specific UBX message.

☞ For more information about power management strategies, see the u-blox M8 Receiver Description Including Protocol Specification [2].

☞ Power Save Mode is only available in GPS mode.

1.16 Antenna

NEO-M8 series modules are designed for use with passive[10] and active[11] antennas.

Parameter	Specification	
Antenna Type		Passive and active antenna
Active Antenna Recommendations	Minimum gain	15 dB (to compensate signal loss in RF cable)
	Maximum gain	50 [12] dB / 30 [13] dB
	Maximum noise figure	1.5 dB

Table 4: Antenna Specifications for all NEO-M8 modules

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[10] For integration NEO-M8 modules with Cellular products, see the NEO-M8 Hardware Integration Manual [1].
[11] For information on using active antennas with NEO-M8 modules, see the NEO-M8 Hardware Integration Manual [1].
[12] NEO-M8M
[13] NEO-M8N/M8Q
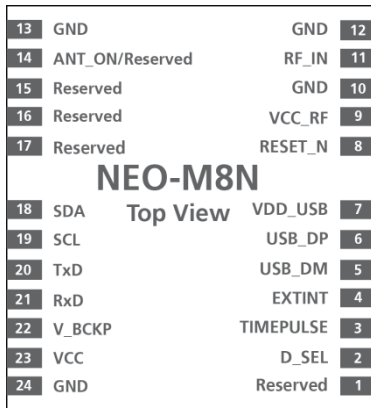
2 Pin Definition

2.1 Pin assignment

Figure 2: Pin Assignment

No	Module	Name	I/O	Description
1	All	Reserved	I	SAFEBOOT_N (for future service, updates and reconfiguration, leave OPEN)
2	All	D_SEL	I	Interface select
3	All	TIMEPULSE	O	Time pulse (1PPS)
4	All	EXTINT	I	External Interrupt Pin
5	All	USB_DM	I/O	USB Data
6	All	USB_DP	I/O	USB Data
7	All	VDD_USB	I	USB Supply
8	All	RESET_N	I	RESET_N
9	All	VCC_RF	O	Output Voltage RF section
10	All	GND	I	Ground
11	All	RF_IN	I	GNSS signal input
12	All	GND	I	Ground
13	All	GND	I	Ground
14	NEO-M8N	ANT_ON	O	Antenna control
	NEO-M8M	Reserved	-	Reserved
	NEO-M8Q	ANT_ON	O	Antenna control
15	All	Reserved	-	Reserved
16	All	Reserved	-	Reserved
17	All	Reserved	-	Reserved
18	All	SDA SPI CS_N	I/O	DDC Data if D_SEL =1 (or open) SPI Chip Select if D_SEL = 0
19	All	SCL SPI CLK	I/O	DDC Clock if D_SEL =1(or open) SPI Clock if D_SEL = 0
20	All	TxD SPI MISO	O	Serial Port if D_SEL =1(or open) SPI MISO if D_SEL = 0
21	All	RxD SPI MOSI	I	Serial Port if D_SEL =1(or open) SPI MOSI if D_SEL = 0
22	All	V_BCKP	I	Backup voltage supply
23	All	VCC	I	Supply voltage
24	All	GND	I	Ground

Table 5: Pinout

☞ Pins designated Reserved should not be used. For more information about Pinouts see the NEO-M8 Hardware Integration Manual [1].

3 Configuration management

Configuration settings can be modified with UBX configuration messages. The modified settings remain effective until power-down or reset. If these settings have been stored in battery-backup RAM, then the modified configuration will be retained, as long as the backup battery supply is not interrupted.

With the NEO-M8N, configuration settings modified with UBX configuration messages can be saved permanently. In this case, the modified settings remain effective even after power-down and do not require backup battery supply.

3.1 Interface Selection (D_SEL)

At startup Pin 2 (D_SEL) determines which data interfaces are used for communication. If D_SEL is set high or left open, UART and DDC become available. If D_SEL is set low, i.e. connected to ground, the NEO-M8 series module can communicate to a host via SPI.

PIN #	D_SEL="1" (left open)	D_SEL ="0" (connected to GND)
20	UART TX	SPI MISO
21	UART RX	SPI MOSI
19	DDC SCL	SPI CLK
18	DDC SDA	SPI CS_N

Table 6: Data interface selection by D_SEL

4 Electrical specification

☞ The limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the characteristics sections of the specification is not implied. Exposure to these limits for extended periods may affect device reliability.

☞ Where application information is given, it is advisory only and does not form part of the specification. For more information see the NEO-M8 Hardware Integration Manual [1].

4.1 Absolute maximum rating

Parameter	Symbol	Module	Condition	Min	Max	Units
Power supply voltage	VCC	All		−0.5	3.6	V
Backup battery voltage	V_BCKP	All		−0.5	3.6	V
USB supply voltage	VDD_USB	All		−0.5	3.6	V
Input pin voltage	Vin	All		−0.5	3.6	V
	Vin_usb	All		−0.5	VDD_USB	V
DC current trough any digital I/O pin (except supplies)	Ipin				10	mA
VCC_RF output current	ICC_RF	All			100	mA
Input power at RF_IN	Prfin	All	source impedance = 50 Ω, continuous wave		15	dBm
Storage temperature	Tstg	NEO-M8M		−40	105	°C
		NEO-M8N/M8Q		−40	85	°C

Table 7: Absolute maximum ratings

⚠ **Stressing the device beyond the "Absolute Maximum Ratings" may cause permanent damage. These are stress ratings only. The product is not protected against overvoltage or reversed voltages. If necessary, voltage spikes exceeding the power supply voltage specification, given in table above, must be limited to values within the specified boundaries by using appropriate protection diodes.**

4.2 Operating conditions

☞ All specifications are at an ambient temperature of 25°C. Extreme operating temperatures can significantly impact specification values. Applications operating near the temperature limits should be tested to ensure the specification.

Parameter	Symbol	Module	Min	Typical	Max	Units	Condition
Power supply voltage	VCC	NEO-M8M	1.65		3.6	V	
		NEO-M8N/Q	2.7	3.0	3.6	V	
Supply voltage USB	VDDUSB	All	3.0	3.3	3.6	V	
Backup battery voltage	V_BCKP	All	1.4		3.6	V	
Backup battery current	I_BCKP	All		15		µA	V_BCKP = 1.8 V, VCC = 0 V
SW backup current	I_SWBCKP	NEO-M8M		22		µA	VCC = 3 V
		NEO-M8N/Q		30		µA	VCC = 3 V
Input pin voltage range	Vin	All	0		VCC	V	
Digital IO Pin Low level input voltage	Vil	All	0		0.2*VCC	V	
Digital IO Pin High level input voltage	Vih	All	0.7*VCC		VCC	V	
Digital IO Pin Low level output voltage	Vol	All			0.4	V	Iol = 4mA
Digital IO Pin High level output voltage	Voh	All	VCC−0.4			V	Ioh = 4mA
Pull-up resistor for RESET_N (internal)	Rpu	All		11		kΩ	
USB_DM, USB_DP	VinU	All	Compatible with USB with 27 Ω series resistance				
VCC_RF voltage	VCC_RF	All		VCC−0.1		V	
VCC_RF output current	ICC_RF	All			50	mA	
Receiver Chain Noise Figure[14]	NFtot	NEO-M8M		3.5		dB	
		NEO-M8N/Q		2.0		dB	
Operating temperature	Topr	All	−40		85	°C	

Table 8: Operating conditions

☞ Operation beyond the specified operating conditions can affect device reliability.

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[14] Only valid for the GPS band

4.3 Indicative current requirements

Table 9 lists examples of the total system supply current for a possible application.

☞ Values in Table 9 are provided for customer information only as an example of typical power requirements. Values are characterized on samples, actual power requirements can vary depending on FW version used, external circuitry, number of SVs tracked, signal strength, type of start as well as time, duration and conditions of test.

Parameter	Symbol	Module	Typ GPS & GLONASS	Typ GPS / QZSS / SBAS	Max	Units	Condition
Max. supply current [15]	Iccp	All			67	mA	
Average supply current [16, 17]	Icc Acquisition[18]	NEO-M8N	34	27		mA	Estimated at 3 V
		NEO-M8M	24.5	19.5		mA	
		NEO-M8Q	29.5	26		mA	
	Icc Tracking (Continuous mode)	NEO-M8N	34	26.5		mA	Estimated at 3 V
		NEO-M8M	23.5	17.5		mA	
		NEO-M8Q	28.5	24		mA	
	Icc Tracking (Power Save mode / 1 Hz)	NEO-M8N	n.a.[19]	10.5		mA	Estimated at 3 V
		NEO-M8M	n.a.[19]	5		mA	
		NEO-M8Q	n.a.[19]	10		mA	

Table 9: Indicative power requirements at 3.0 V

☞ For more information about power requirements, see the NEO-M8 Hardware Integration Manual [1].

☞ For more information on how to noticeably reduce current consumption, see the Power Management Application Note [4].

4.4 SPI timing diagrams

In order to avoid incorrect operation of the SPI, the user needs to comply with certain timing conditions. The following signals need to be considered for timing constraints:

Symbol	Description
SPI CS_N (SS_N)	Slave select signal
SPI CLK (SCK)	Slave clock signal

Table 10: Symbol description

[15] Use this figure to dimension maximum current capability of power supply. Measurement of this parameter with 1 Hz bandwidth.
[16] Use this figure to determine required battery capacity.
[17] Simulated GNSS constellation using power levels of -130 dBm. VCC = 3.0 V
[18] Average current from start-up until the first fix.
[19] Not applicable

Figure 3: SPI timing diagram

4.4.1 Timing recommendations

The recommendations below are based on a firmware running from Flash memory.

Parameter	Description	Recommendation
t_{INIT}	Initialization Time	500 μs
t_{DES}	Deselect Time	1 ms.
Bit rate		1 Mb/s

Table 11: SPI timing recommendations

☞ The values in the above table result from the requirement of an error-free transmission. By allowing just a few errors and disabling the glitch filter, the bit rate can be increased considerably.

4.5 DDC timing diagrams

The DDC interface is I²C Fast Mode compliant. For timing parameters consult the I²C standard.

☞ The maximum bit rate is 400 kb/s. The interface stretches the clock when slowed down when serving interrupts, so real bit rates may be slightly lower.
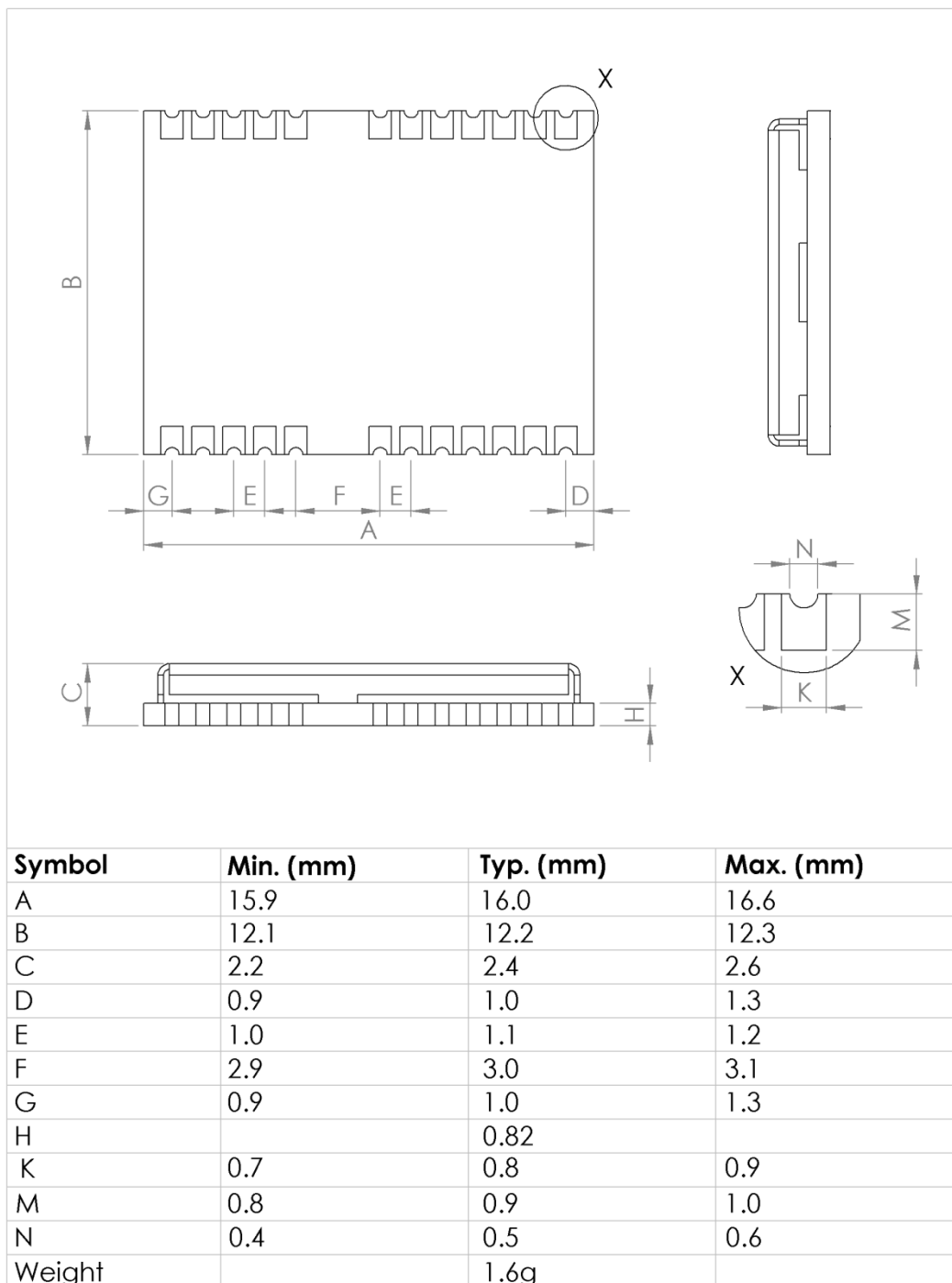
5 Mechanical specifications

Symbol	Min. (mm)	Typ. (mm)	Max. (mm)
A	15.9	16.0	16.6
B	12.1	12.2	12.3
C	2.2	2.4	2.6
D	0.9	1.0	1.3
E	1.0	1.1	1.2
F	2.9	3.0	3.1
G	0.9	1.0	1.3
H		0.82	
K	0.7	0.8	0.9
M	0.8	0.9	1.0
N	0.4	0.5	0.6
Weight		1.6g	

Figure 4: Dimensions

☞   For information about the paste mask and footprint, see the NEO-M8 Hardware Integration Manual [1].

6 Reliability tests and approvals

6.1 Reliability tests

☞ All NEO-M8 series modules are based on AEC-Q100 qualified GNSS chips.

Tests for product family qualifications are according to ISO 16750 "Road vehicles – environmental conditions and testing for electrical and electronic equipment", and appropriate standards.

6.2 Approvals

Products marked with this lead-free symbol on the product label comply with the "Directive 2002/95/EC of the European Parliament and the Council on the Restriction of Use of certain Hazardous Substances in Electrical and Electronic Equipment" (RoHS).

All u-blox M8 GNSS modules are RoHS compliant.

7 Product handling & soldering

7.1 Packaging

The NEO-M8 series GNSS modules are delivered as hermetically sealed, reeled tapes in order to enable efficient production, production lot set-up and tear-down. For more information see the u-blox Package Information Guide [3].

7.1.1 Reels

The NEO-M8 series GNSS modules are deliverable in quantities of 250 pcs on a reel. The NEO-M8 receivers are shipped on Reel Type B, as specified in the u-blox Package Information Guide [3][2].

7.1.2 Tapes

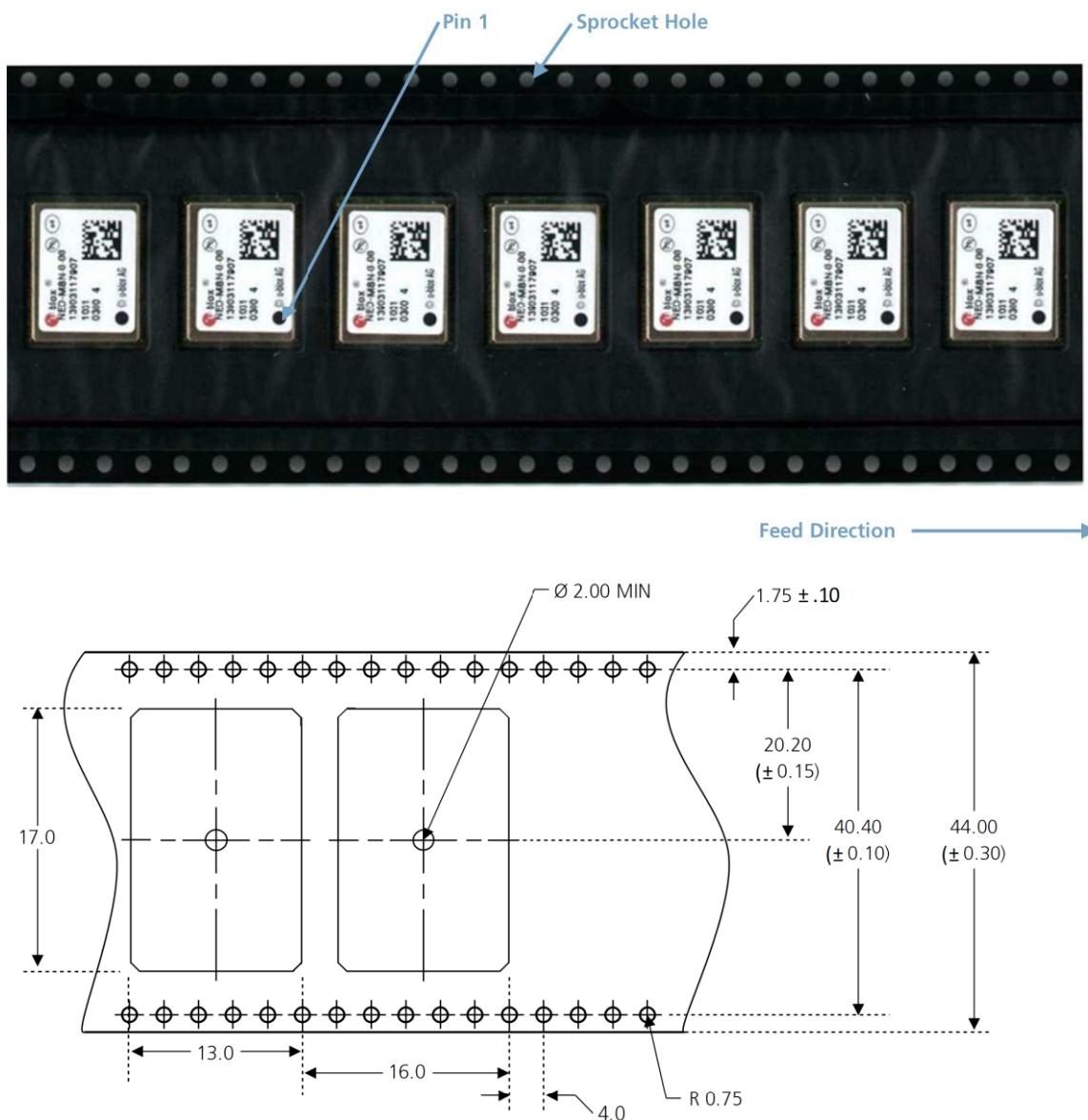The dimensions and orientations of the tapes for NEO-M8 modules are specified in Figure 5.

Figure 5: Dimensions and orientation for NEO-M8 modules on tape

7.2 Shipment, storage and handling

For important information regarding shipment, storage and handling see the u-blox Package Information Guide [3].

7.2.1 Moisture Sensitivity Levels

The Moisture Sensitivity Level (MSL) relates to the packaging and handling precautions required. The NEO-M8 modules are rated at MSL level 4.

☞ For MSL standard see IPC/JEDEC J-STD-020, which can be downloaded from www.jedec.org.

☞ For more information regarding MSL see the u-blox Package Information Guide [3].

7.2.2 Reflow soldering

Reflow profiles are to be selected according u-blox recommendations (see the NEO-M8 Hardware Integration Manual [1]).
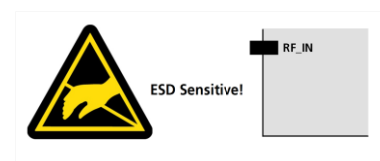
7.2.3 ESD handling precautions

⚠ **NEO-M8 series modules are Electrostatic Sensitive Devices (ESD). Observe precautions for handling! Failure to observe these precautions can result in severe damage to the GNSS receiver!**

GNSS receivers are Electrostatic Sensitive Devices (ESD) and require special precautions when handling. Particular care must be exercised when handling patch antennas, due to the risk of electrostatic charges. In addition to standard ESD safety practices, the following measures should be taken into account whenever handling the receiver:

- Unless there is a galvanic coupling between the local GND (i.e. the work table) and the PCB GND, then the first point of contact when handling the PCB must always be between the local GND and PCB GND.

- Before mounting an antenna patch, connect ground of the device

- When handling the RF pin, do not come into contact with any charged capacitors and be careful when contacting materials that can develop charges (e.g. patch antenna ~10 pF, coax cable ~50-80 pF/m, soldering iron, …)

- To prevent electrostatic discharge through the RF input, do not touch any exposed antenna area. If there is any risk that such exposed antenna area is touched in non ESD protected work area, implement proper ESD protection measures in the design.

- When soldering RF connectors and patch antennas to the receiver's RF pin, make sure to use an ESD safe soldering iron (tip).

8 Default messages

Interface	Settings
UART Output	9600 Baud, 8 bits, no parity bit, 1 stop bit Configured to transmit both NMEA and UBX protocols, but only the following NMEA (and no UBX) messages have been activated at start-up: **GGA, GLL, GSA, GSV, RMC, VTG, TXT**
USB Output	Configured to transmit both NMEA and UBX protocols, but only the following NMEA (and no UBX) messages have been activated at start-up: **GGA, GLL, GSA, GSV, RMC, VTG, TXT** USB Power Mode: Bus Powered
UART Input	9600 Baud, 8 bits, no parity bit, 1 stop bit, Autobauding disabled Automatically accepts following protocols without need of explicit configuration: UBX, NMEA, RTCM The GNSS receiver supports interleaved UBX and NMEA messages.
USB Input	Automatically accepts following protocols without need of explicit configuration: UBX, NMEA The GPS receiver supports interleaved UBX and NMEA messages. USB Power Mode: Bus Powered
DDC	Fully compatible with the I²C industry standard, available for communication with an external host CPU or u-blox cellular modules, operated in slave mode only. Default messages activated. NMEA and UBX are enabled as input messages, only NMEA as output messages. Maximum bit rate 400 kb/s.
SPI	Allow communication to a host CPU, operated in slave mode only. Default messages activated. SPI is not available in the default configuration.
TIMEPULSE (1 Hz Nav)	1 pulse per second, synchronized at rising edge, pulse length 100ms

Table 12: Default messages

☞ Refer to the u-blox M8 Receiver Description Including Protocol Specification [2] for information about further settings.

9 Labeling and ordering information

9.1 Product labeling

The labeling of u-blox M8 GNSS modules includes important product information. The location of the NEO-M8 product type number is shown in Figure 6.
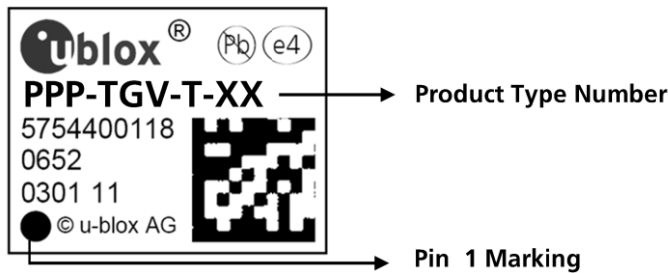

Figure 6: Location of product type number on u-blox NEO-M8 module label

9.2 Explanation of codes

Three different product code formats are used. The **Product Name** is used in documentation such as this data sheet and identifies all u-blox M8 products, independent of packaging and quality grade. The **Ordering Code** includes options and quality, while the **Type Number** includes the hardware and firmware versions. Table 13 shows the structure of these three different formats.

Format	Structure
Product Name	PPP-TGV
Ordering Code	PPP-TGV-T
Type Number	PPP-TGV-T-XX

Table 13: Product Code Formats

The parts of the product code are explained in Table 14.

Code	Meaning	Example
PPP	Product Family	NEO
TG	Platform	M8 = u-blox M8
V	Variant	Function set (A-Z), T = Timing, R = DR, etc.
T	Option / Quality Grade	Describes standardized functional element or quality grade 0 = Default variant, A = Automotive
XX	Product Detail	Describes product details or options such as hard- and software revision, cable length, etc.

Table 14: part identification code

9.3 Ordering codes

Ordering No.	Product
NEO-M8M-0	u-blox M8 Concurrent GNSS LCC Module, crystal, ROM, 12.2x16 mm, 250 pcs/reel
NEO-M8N-0	u-blox M8 Concurrent GNSS LCC Module, TCXO, flash, SAW, LNA, 12.2x16 mm, 250 pcs/reel
NEO-M8Q-0	u-blox M8 Concurrent GNSS LCC Module, TCXO, ROM, SAW, LNA, 12.2x16 mm, 250 pcs/reel

Table 15: Product ordering codes for professional grade modules

☞ Product changes affecting form, fit or function are documented by u-blox. For a list of Product Change Notifications (PCNs) see our website.

Related documents

[1]   NEO-M8 Hardware Integration Manual, Docu. No. UBX-13003557

[2]   u-blox M8 Receiver Description Including Protocol Specification (Public version), Docu. No. UBX-13003221

[3]   u-blox Package Information Guide, Docu. No. UBX-14001652

[4]   Power Management Application Note, Docu. No. UBX-13005162

☞   For regular updates to u-blox documentation and to receive product change notifications, register on our homepage (http://www.u-blox.com).

Revision history

Revision	Date	Name	Status / Comments
1	28-Aug-2013	svin	Objective Specification.
R02	17-Dec-2013	julu	Updated ROM/Flash versions. Added NEO-M8Q product variant in relevant sections. Updated sections 1.1 and 1.2 (Product features). Updated performance figures in Table 1. Updated section 1.4 (removed "optional" from RTC crystal), section 1.6.3 (AssistNow Autonomous) and section 1.9 (Added SQI flash memory size info). Added section 1.8 Odometer. Updated Table 3, Table 7 (e.g. Storage temperature) and Table 8. Updated power consumption figures in Table 9. Added Power Management Application Note reference in section 4.3. Added DDC and SPI interfaces in Table 12.
R03	28-Jan-2014	smos	Revised section Indicative current requirements.
R04	06-Feb-2014	julu	Removed I/O supply from Figure 1 (Block Diagram).
R05	26-Feb-2014	julu	Advance Information. Updated Table 1 (added GPS & BeiDou concurrent and GPS only modes) and Table 9 (Indicative current requirements).
R06	07-Apr-2014	julu	Updated section 1.2 (product selector table); updated Table 1 (improved tracking sensitivities of GPS and GPS & BeiDou for NEO-M8M, horizontal position accuracy): added recommendation for using passive antenna (footnote in Table 4); added software backup current values in Table 8.
R07	27-Aug-2014	julu	Early Production Information. Added SAFEBOOT_N description in section 1.13.1 and Table 5 (PIN 1).
R08	17-Nov-2014	julu	Updated section 1.2 (added product grade information to selector table)
R09	01-Dec-2014	julu	Production Information.
R10	21-Oct-2015	julu	Updated product type number for NEO-M8M/Q and added relevant PCN references

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