

# NEO-7

## u-blox 7 GPS/GNSS modules

### Data Sheet

#### Highlights:

- Multi-GNSS engine for GPS, GLONASS, Galileo and QZSS
- Product variants to meet performance and cost requirements
- Combines low power consumption and high sensitivity
- Simple integration with u-blox wireless modules
- Backward compatible with NEO-6 and NEO-5 families



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**Document Information**

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**Document status information**

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| Objective Specification | This document contains target values. Revised and supplementary data will be published later.                 |
| Advance Information     | This document contains data based on early testing. Revised and supplementary data will be published later.   |
| Preliminary             | This document contains data from product verification. Revised and supplementary data may be published later. |
| Released                | This document contains the final product specification.   |

**This document applies to the following products:**

| <b>Name</b> | <b>Type number</b> | <b>ROM/FLASH version</b> | <b>PCN reference</b> |
|-------------|--------------------|--------------------------|----------------------|
| NEO-7M-0    | NEO-7M-0-000       | ROM1.00                  | N/A                  |
| NEO-7N-0    | NEO-7N-0-000       | FW1.00                   | N/A                  |

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# 1 Functional description

## 1.1 Overview

The NEO-7 series of standalone GPS/GNSS modules benefit from the exceptional performance of the u-blox 7 multi-GNSS (GPS, GLONASS, Galileo, QZSS and SBAS) engine. The NEO-7 series delivers high sensitivity and minimal acquisition times in the industry-proven NEO form factor.

The NEO-7 series provides maximum sensitivity while maintaining low system power. The NEO-7M is optimized for cost sensitive applications, while NEO-7N provides best performance and easy RF integration. The NEO form factor allows easy migration from previous NEO generations. Sophisticated RF-architecture and interference suppression ensure maximum performance even in GPS-hostile environments.

The NEO-7 series combines a high level of integration capability with flexible connectivity options in a miniature package. This makes it perfectly suited for industrial applications with strict size and cost requirements. The I<sup>2</sup>C compatible DDC interface provides connectivity and enables synergies with u-blox SARA, LEON and LISA wireless modules.

u-blox 7 modules use GPS/GNSS chips qualified according to AEC-Q100 and are manufactured in ISO/TS 16949 certified sites. Qualification tests are performed as stipulated in the ISO16750 standard: "Road vehicles – Environmental conditions and testing for electrical and electronic equipment".

## 1.2 Product features

| Model  | Type |      |         | Supply |                |                           | Interfaces    |                |                      |      | Features |     |                                  |                      |             |                     |                      |            |             |                |  |                                    |           |                           |
|--------|------|------|---------|--------|----------------|---------------------------|---------------|----------------|----------------------|------|----------|-----|----------------------------------|----------------------|-------------|---------------------|----------------------|------------|-------------|----------------|--|------------------------------------|-----------|---------------------------|
|        | GPS  | QZSS | GLONASS | Timing | Dead Reckoning | Precise Point Positioning | 2.7 V - 3.6 V | 1.65 V - 3.6 V | Lowest power (DC/DC) | UART | USB      | SPI | DDC (I <sup>2</sup> C compliant) | Programmable (Flash) | Data logger | Extra front-end LNA | Front-end SAW filter | Oscillator | RTC crystal | Antenna supply | Antenna short circuit detection / protection | Antenna open circuit detection pin | Timepulse | External interrupt/Wakeup |
| NEO-7N | ●    | ●    | ●       |        |                |                           | ●             | ●              |                      | ●    | ●        | Sel | ●                                | ●                    | ●           | ●                   | ●                    | T          | ●           | ○              | ○  | ○                                  | ●         | ●                         |
| NEO-7M | ●    | ●    | ●       |        |                |                           | ●             | ●              |                      | ●    | ●        | Sel | ●                                |                      |             |                     |                      | C          | ●           | ○              | ○  | ○                                  | ●         | ●                         |

Sel = Select for either SPI or UART/DDC by HW configuration pin (D\_SEL)  
 ○ = Optional, not activated per default or requires external components

C = Crystal / T = TCXO

## 1.3 GNSS performance

### 1.3.1 GPS performance

| Parameter                                 | Specification  |                                   |          |
|---|--|-----------------------------------|----------|
| Receiver type                             | 56 Channels<br>GPS L1C/A<br>SBAS L1C/A<br>QZSS L1C/A<br>GALILEO E1B/C <sup>1</sup> |                                   |          |
| Time-To-First-Fix <sup>2</sup>            |  | NEO-7N                            | NEO-7M   |
|   | Cold Start   | 29 s                              | 30 s     |
|   | Warm Start   | 28 s                              | 28 s     |
|   | Hot Start  | 1 s                               | 1 s      |
|   | Aided Starts <sup>3</sup>  | 5 s                               | 5 s      |
| Sensitivity <sup>4</sup>                  |  | NEO-7N                            | NEO-7M   |
|   | Tracking & Navigation  | -162 dBm                          | -161 dBm |
|   | Reacquisition  | -160 dBm                          | -160 dBm |
|   | Cold Start   | -148 dBm                          | -147 dBm |
|   | Warm Start   | -148 dBm                          | -148 dBm |
| Horizontal position accuracy <sup>5</sup> | Autonomous   | 2.5 m                             |          |
|   | SBAS   | 2.0 m                             |          |
| Accuracy of time pulse signal             | RMS  | 30 ns                             |          |
|   | 99%  | 60 ns                             |          |
| Frequency of time pulse signal            |  | 0.25 Hz ... 10 MHz (configurable) |          |
| Max navigation update rate                |  | 10 Hz                             |          |
| Velocity accuracy <sup>6</sup>            |  | 0.1 m/s                           |          |
| Heading accuracy <sup>6</sup>             |  | 0.5 degrees                       |          |
| Operational limits <sup>7</sup>           | Dynamics   | ≤ 4 g                             |          |
|   | Altitude   | 50,000 m                          |          |
|   | Velocity   | 500 m/s                           |          |

**Table 1: GPS performance**

<sup>1</sup> Ready to support GALILEO E1B/C when available

<sup>2</sup> All satellites at -130 dBm

<sup>3</sup> Dependent on aiding data connection speed and latency

<sup>4</sup> Demonstrated with a good external LNA

<sup>5</sup> CEP, 50%, 24 hours static, -130 dBm, > 6 SVs

<sup>6</sup> 50% @ 30 m/s

<sup>7</sup> Assuming Airborne < 4 g platform

### 1.3.2 GLONASS performance

| Parameter                                  | Specification               |                                   |          |
|--|-----------------------------|-----------------------------------|----------|
| Receiver type                              | 56 Channels<br>GLONASS L1OF |                                   |          |
| Time-To-First-Fix <sup>8</sup>             |                             | NEO-7N                            | NEO-7M   |
|  | Cold Start                  | 30 s                              | 32 s     |
|  | Warm Start                  | 25 s                              | 25 s     |
|  | Hot Start                   | 1 s                               | 1 s      |
| Sensitivity <sup>9</sup>                   |                             | NEO-7N                            | NEO-7M   |
|  | Tracking & Navigation       | -158 dBm                          | -158 dBm |
|  | Reacquisition               | -156 dBm                          | -156 dBm |
|  | Cold Start                  | -140 dBm                          | -139 dBm |
|  | Warm Start                  | -145 dBm                          | -145 dBm |
|  | Hot Start                   | -156 dBm                          | -155 dBm |
| Horizontal position accuracy <sup>10</sup> |                             | 4.0 m                             |          |
| Accuracy of time pulse signal              | RMS                         | 50 ns                             |          |
|  | 99%                         | 100 ns                            |          |
| Frequency of time pulse signal             |                             | 0.25 Hz ... 10 MHz (configurable) |          |
| Max navigation update rate                 |                             | 1 Hz                              |          |
| Velocity accuracy <sup>11</sup>            |                             | 0.1 m/s                           |          |
| Heading accuracy <sup>6</sup>              |                             | 0.5 degrees                       |          |
| Operational limits <sup>12</sup>           | Dynamics                    | ≤ 4 g                             |          |
|  | Altitude                    | 50,000 m                          |          |
|  | Velocity                    | 500 m/s                           |          |

**Table 2: GLONASS performance**

<sup>8</sup> All satellites at -130 dBm

<sup>9</sup> Demonstrated with a good external LNA

<sup>10</sup> CEP, 50%, 24 hours static, -130 dBm, > 6 SVs

<sup>11</sup> 50% @ 30 m/s

<sup>12</sup> Assuming Airborne < 4 g platform

## 1.4 Block diagram

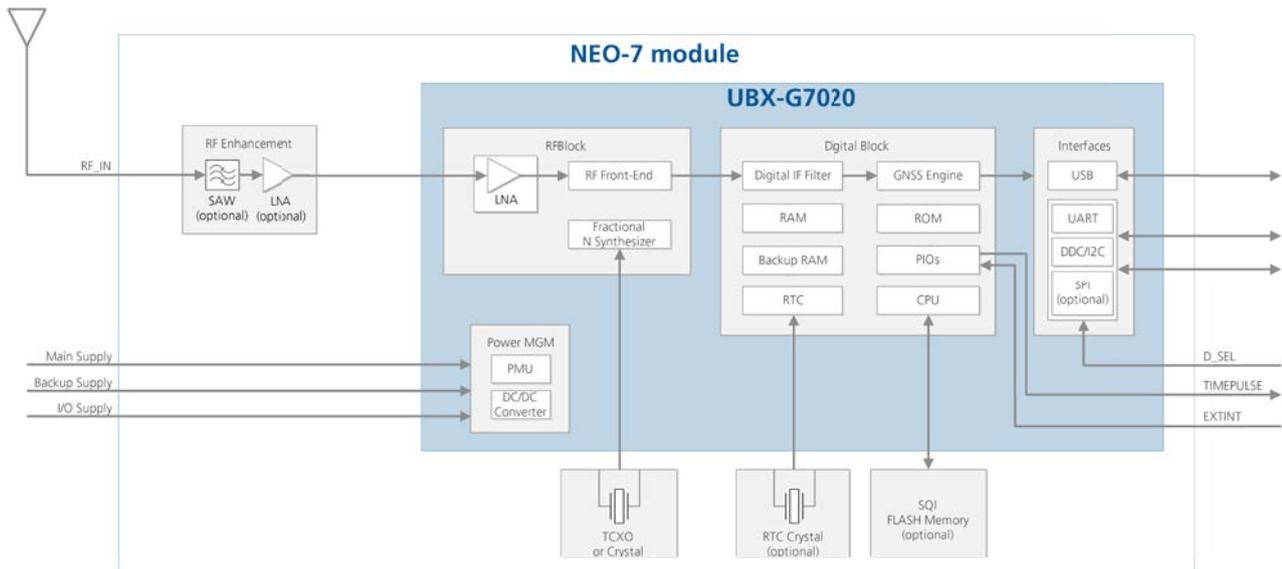


Figure 1: NEO-7 block diagram

## 1.5 GNSS

u-blox 7 positioning modules are multi-GNSS receivers and can receive and track GPS, GLONASS, GALILEO and QZSS signals.

### 1.5.1 GPS

u-blox 7 receivers are designed to receive and track the L1C/A signals provided at 1575.42 MHz by the Global Positioning System (GPS).

### 1.5.2 GLONASS

The Russian GLONASS satellite system is an alternative system to the US-based Global Positioning System (GPS). The u-blox 7 module is capable of receiving and processing GLONASS signals using the same hardware and provides the lowest power GLONASS functionality in the industry at low cost and with minimal integration effort. In order to take advantage of GPS and GLONASS, dedicated hardware preparation must be taken during the design-in phase, see the *MAX-7 / NEO-7 / LEA-7 Hardware Integration Manual* [1] for u-blox design recommendations.

The ability to receive and track GLONASS L1OF satellite signals with the same hardware results in an optimized hardware BOM and allows design of GLONASS ready receivers where required by regulations.

### 1.5.3 QZSS

The Quasi-Zenith Satellite System (QZSS) is a navigation satellite overlay system for the Pacific region covering Japan and Australia which transmits additional GPS L1C/A signals. u-blox 7 positioning modules are able to receive and to track these signals simultaneously with GPS, resulting in better availability, especially under bad signal conditions e.g. in urban canyons.

## 1.6 Augmented GPS

### 1.6.1 Assisted GPS (A-GPS)

A-GPS improves GPS performance by delivering aiding data to the GPS receiver via wireless networks or the Internet. Supplying information such as ephemeris, almanac, approximate last position, time and satellite status and an optional time synchronization signal significantly reduces Time to First Fix (TTFF) and improves acquisition sensitivity.

AssistNow Online and AssistNow Offline are u-blox' end-to-end A-GPS services for devices with or without network connectivity. AssistNow Online and AssistNow Offline can either be used alone or in combination. They are very easy to implement, require no additional hardware, and generate virtually no CPU load. All u-blox 7 modules support u-blox' AssistNow Online, AssistNow Offline and AssistNow Autonomous A-GPS services, and are OMA SUPL compliant.

#### AssistNow Online

With AssistNow Online, an internet-connected GPS 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.

#### AssistNow Offline

With AssistNow Offline, users download u-blox' Differential Almanac Correction Data from the Internet at their convenience. The correction data can either be stored in the GPS/GNSS receiver's Flash memory (available on NEO-7N only) or in the memory of the application processor. Therefore, the service requires no connectivity at system start-up and enables a position fix within seconds, even when no network is available.

### 1.6.2 AssistNow Autonomous

AssistNow Autonomous provides functionality similar to Assisted-GPS without the need for a host or external network connection. It is an embedded feature available free-of-charge that accelerates GPS positioning by capitalizing on the periodic nature of GPS satellite orbits. GPS orbit predictions are directly calculated by the GPS receiver and no external aiding data or connectivity is required. AssistNow Autonomous can be used alone, or together with AssistNow Online or AssistNow Offline for increased positioning speed and accuracy.



For more details see the *u-blox 7 Receiver Description Including Protocol Specification* [2].

### 1.6.3 Satellite-Based Augmentation System (SBAS)

u-blox 7 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 which can be used by GPS receivers to improve the resulting GPS precision. SBAS satellites can be used as additional satellites for ranging (navigation), further enhancing precision. The following SBAS are supported with u-blox 7: WAAS, EGNOS and MSAS.



For more details see the *u-blox 7 Receiver Description Including Protocol Specification* [2].

## 1.7 Data logging (NEO-7N)

New with u-blox 7 is the data logging feature, which enables continuous storage of position, velocity and time information to an internal 16Mbit SQI FLASH memory. 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 7 Receiver Description Including Protocol Specification* [2].

## 1.8 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 7 Receiver Description including Protocol Specification* [2] and the *MAX-7 / NEO-7 / LEA-7 Hardware Integration Manual* [1].

### 1.8.1 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.

### 1.8.2 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.

## 1.9 TIMEPULSE

A configurable time pulse signal is available with all u-blox 7 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 7 Receiver Description including Protocol Specification* [2].

## 1.10 Protocols and interfaces

| Protocol | Type   |
|----------|--|
| NMEA     | Input/output, ASCII, 0183, 2.3 (compatible to 3.0) |
| UBX      | Input/output, binary, u-blox proprietary           |
| RTCM     | Input, 2.3   |

**Table 3: Available Protocols**

All protocols are available on UART, USB, DDC (I<sup>2</sup>C compliant) and SPI. For specification of the various protocols see the *u-blox 7 Receiver Description Including Protocol Specification* [2].

## 1.11 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.

### 1.11.1 UART

NEO-7 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 7 Receiver Description Including Protocol Specification* [2].

### 1.11.2 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 provides a Microsoft® certified USB driver for Windows XP, Windows Vista and Windows 7 operating systems.

### 1.11.3 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).

### 1.11.4 Display Data Channel (DDC)

An I<sup>2</sup>C compliant DDC interface is available for communication with an external host CPU or u-blox Wireless 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<sup>2</sup>C industry standard. Since the maximum SCL clock frequency is 400 kHz, the maximum transfer rate is 400 kb/s.

## 1.12 Clock generation

### 1.12.1 Oscillators

NEO-7 GPS modules are available in Crystal and TCXO versions. The TCXO allows accelerated weak signal acquisition, enabling faster start and reacquisition times.

### 1.12.2 Real-Time Clock (RTC)

The RTC is driven by a 32 kHz oscillator, which makes use of an external 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 later allow a hot or warm start.

## 1.13 Power management

u-blox 7 technology offers a power-optimized architecture with built-in autonomous power saving functions to minimize power consumption at any given time. An integrated high efficiency DC/DC converter allows low power consumption even for higher main supply voltages. The receiver can be operated in two operating modes: Continuous Mode or Power Save Mode.

### 1.13.1 DC/DC converter

NEO-7 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 *MAX-7 / NEO-7 / LEA-7 Hardware Integration Manual* [1]

### 1.13.2 Operating modes

u-blox 7 modules have two operating modes:

- Continuous Mode for best GPS/GNSS performance
- Power Save Mode to optimize power consumption

#### 1.13.2.1 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 GPS/GNSS position is obtained

- The entire Almanac has been downloaded
- The Ephemeris for each satellite in view is valid

### 1.13.2.2 Power Save Mode

For power sensitive applications, u-blox 7 receivers provide a Power Save Mode for reduced power consumption. Power Save Mode uses two dedicated operations called 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 7 Receiver Description Including Protocol Specification* [2].



Power Save Mode is not available in GLONASS mode.

## 1.14 Antenna

NEO-7 modules are designed for use with passive and active<sup>13</sup> 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 <sup>14</sup> dB / 30 <sup>15</sup> dB     |
|                                | Maximum noise figure       | 1.5 dB  |

**Table 4: Antenna Specifications for all NEO-7 modules**

<sup>13</sup> For information on using active antennas with NEO-7 modules, see the *NEO-7 Hardware Integration Manual* [1].

<sup>14</sup> NEO-7M

<sup>15</sup> NEO-7N

## 2 Pin Definition

### 2.1 Pin assignment

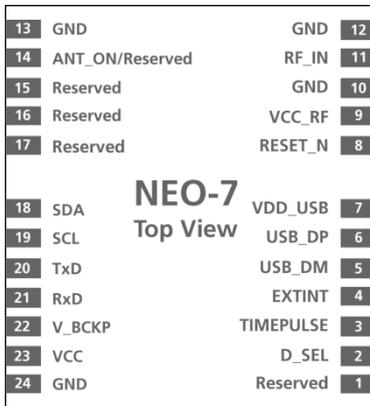


Figure 2: Pin Assignment

| No | Module | Name            | I/O | Description  |
|----|--------|-----------------|-----|--|
| 1  | All    | Reserved        | I   | Reserved   |
| 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   | GPS signal input   |
| 12 | All    | GND             | I   | Ground   |
| 13 | All    | GND             | I   | Ground   |
| 14 | NEO-7N | ANT_ON          | O   | Antenna control  |
| 15 | NEO-7M | Reserved        | -   | Reserved   |
| 16 | All    | Reserved        | -   | Reserved   |
| 17 | All    | Reserved        | -   | Reserved   |
| 18 | All    | SDA<br>SPI CS_N | I/O | DDC Data if D_SEL =1 (or open)<br>SPI Chip Select if D_SEL = 0 |
| 19 | All    | SCL<br>SPI CLK  | I/O | DDC Clock if D_SEL =1(or open)<br>SPI Clock if D_SEL = 0       |
| 20 | All    | TxD<br>SPI MISO | O   | Serial Port if D_SEL =1(or open)<br>SPI MISO if D_SEL = 0      |
| 21 | All    | RxD<br>SPI MOSI | I   | Serial Port if D_SEL =1(or open)<br>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 *MAX-7 / NEO-7 / LEA-7 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-7N, 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 the 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 Module can communicate to a host via SPI.

| PIN # | D_SEL="1"<br>(left open) | D_SEL = "0"<br>(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 *MAX-7 / NEO-7 / LEA-7 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 through 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 |      | 13      | dBm   |
| Storage temperature                                      | Tstg    | All    |  | -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-7M | 1.65  |         | 3.6     | V     |                             |
|  |        | NEO-7N | 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,<br>VCC = 0V |
| 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                     |
| USB_DM, USB_DP                           | VinU   | All    | Compatible with USB with 22 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              | NFtot  | NEO-7M |   | 3.5     |         | dB    |                             |
|  |        | NEO-7N |   | 2.0     |         | dB    |                             |
| Operating temperature                    | Topr   | All    | -40   |         | 85      | °C    |                             |

**Table 8: Operating conditions**



Operation beyond the specified operating conditions can affect device reliability.

### 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 | Min | Typ | Max | Units | Condition       |
|--|--|--------|-----|-----|-----|-------|-----------------|
| Max. supply current <sup>16</sup>        | lccp                                     | All    |     |     | 67  | mA    |                 |
|  | lcc Acquisition <sup>19</sup>            | NEO-7N |     | 32  |     | mA    |                 |
|  |  | NEO-7M |     | 22  |     | mA    | Estimated at 3V |
| Average supply current <sup>17, 18</sup> | lcc Tracking<br>(Continuous mode,)       | NEO-7N |     | 26  |     | mA    |                 |
|  |  | NEO-7M |     | 17  |     | mA    | Estimated at 3V |
|  | lcc Tracking<br>(Power Save mode / 1 Hz) | NEO-7N |     | 11  |     | mA    |                 |
|  |  | NEO-7M |     | 5   |     | mA    | Estimated at 3V |

**Table 9: Indicative power requirements at 3.0 V**



For more information about power requirements, see the *MAX-7 / NEO-7 / LEA-7 Hardware Integration Manual* [1]

<sup>16</sup> Use this figure to dimension maximum current capability of power supply. Measurement of this parameter with 1 Hz bandwidth.

<sup>17</sup> Use this figure to determine required battery capacity.

<sup>18</sup> Simulated constellation of 8 satellites is used. All signals are at -130 dBm.

<sup>19</sup> Average current from start-up until the first fix.

## 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

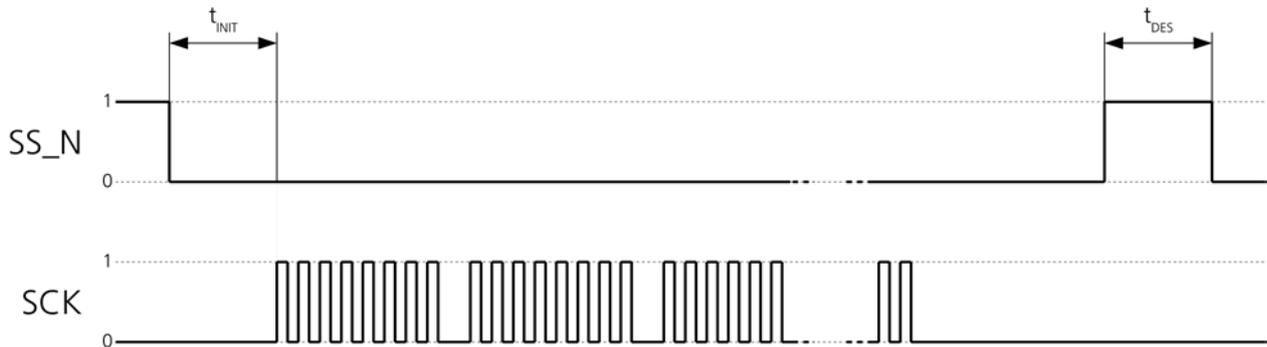


Figure 3: SPI timing diagram

### 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 $\mu$ s    |
| $t_{DES}$  | 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.

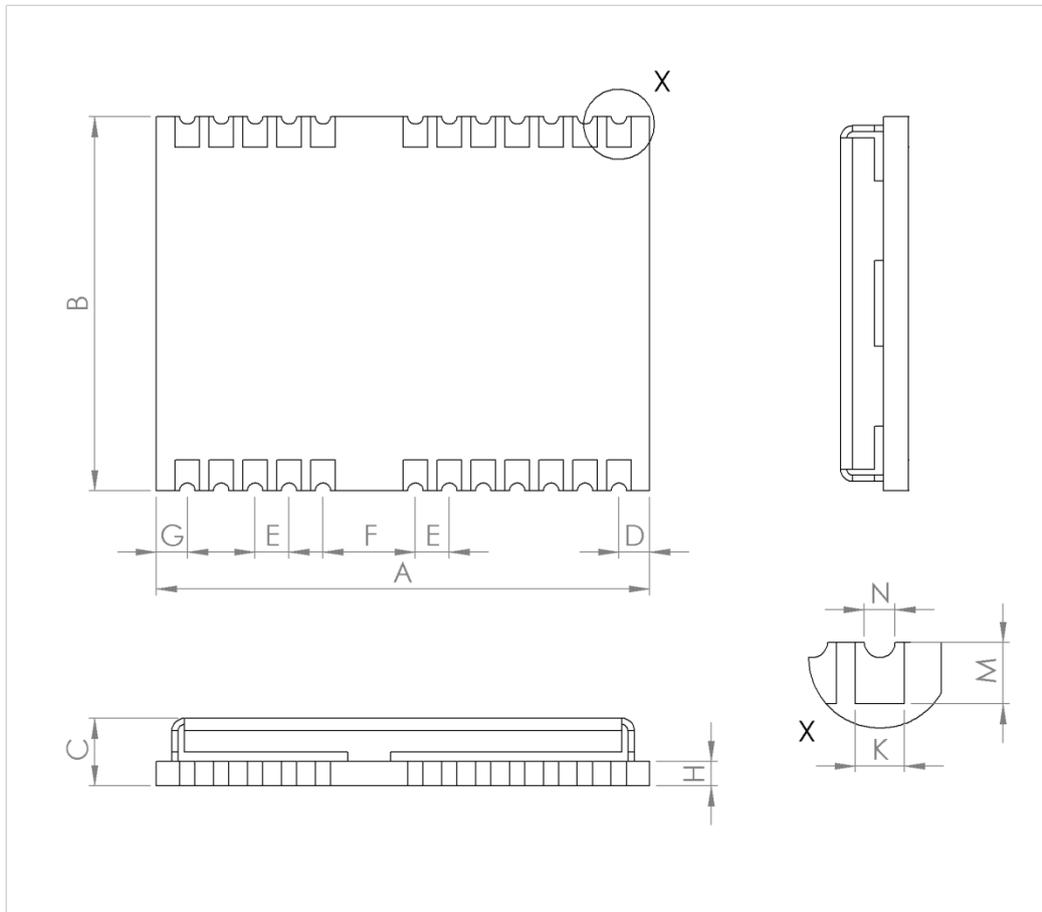
## 4.5 DDC timing diagrams

The DDC interface is I<sup>2</sup>C Fast Mode compliant. For timing parameters consult the I<sup>2</sup>C 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 regarding the Paste Mask and Footprint see the *NEO-7 Hardware Integration Manual [1]*.

## 6 Reliability tests and approvals

### 6.1 Reliability tests



All NEO-7 modules are based on AEC-Q100 qualified GPS 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 7 GNSS modules are RoHS compliant.

## 7 Product handling & soldering

### 7.1 Packaging

NEO-7 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* [2].

#### 7.1.1 Reels

NEO-7 GPS modules are deliverable in quantities of 250pcs on a reel. NEO-7 modules are shipped on Reel Type B, as specified in the *u-blox Package Information Guide* [2].

#### 7.1.2 Tapes

The dimensions and orientations of the tapes for NEO-7 modules are specified in Figure 5.

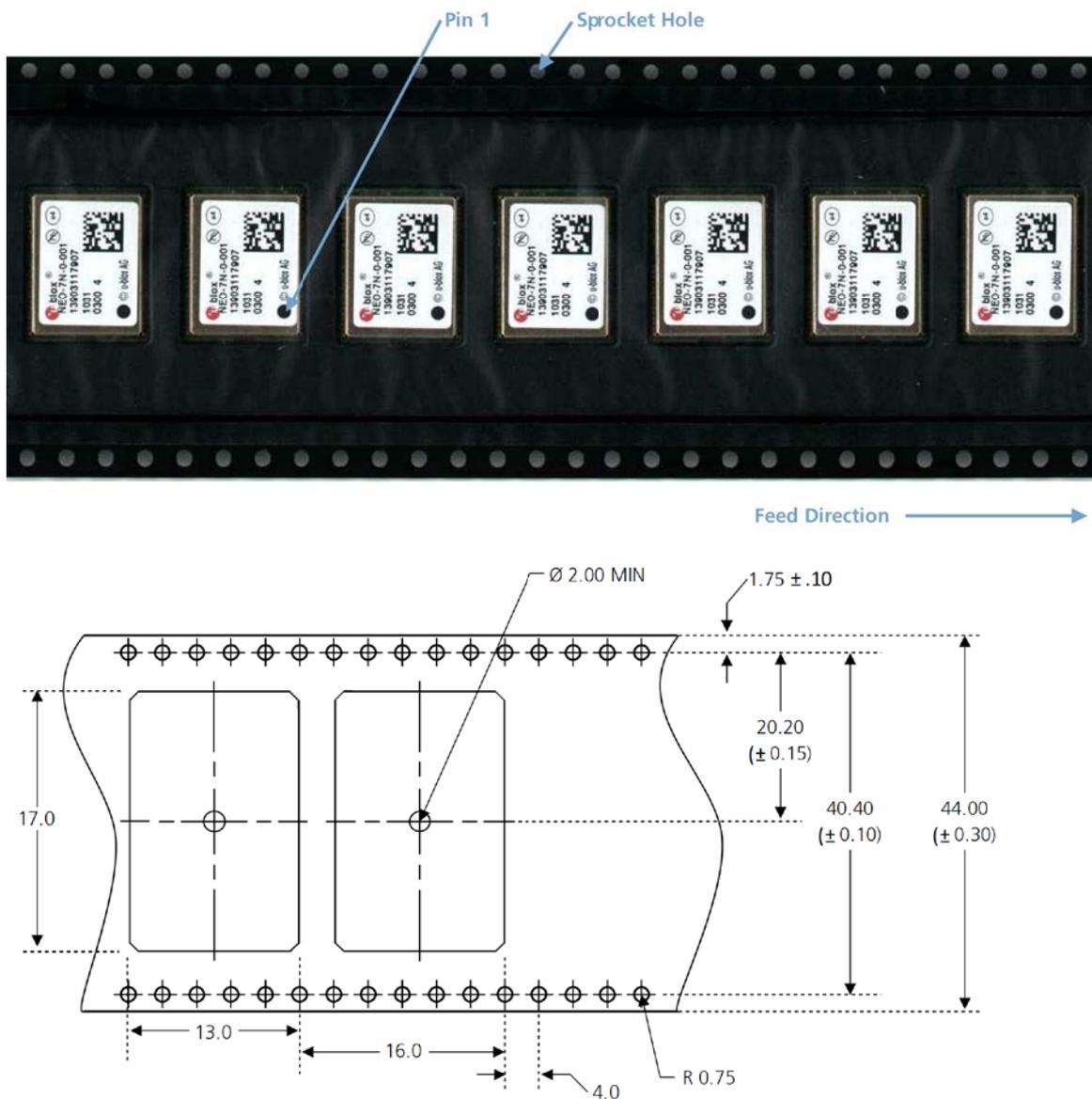


Figure 5: Dimensions and orientation for NEO-7 modules on tape

## 7.2 Shipment, storage and handling

For important information regarding shipment, storage and handling see the *u-blox Package Information Guide* [2].

### 7.2.1 Moisture Sensitivity Levels

The Moisture Sensitivity Level (MSL) relates to the packaging and handling precautions required. NEO-7 modules are rated at MSL level 4.



For MSL standard see IPC/JEDEC J-STD-020, which can be downloaded from [www.jedec.org](http://www.jedec.org).



For more information regarding MSL see the *u-blox Package Information Guide* [2].

### 7.2.2 Reflow soldering

Reflow profiles are to be selected according u-blox recommendations (see *MAX-7 / NEO-7 / LEA-7 Hardware Integration Manual* [1]).

### 7.2.3 ESD handling precautions



**NEO-7 modules are Electrostatic Sensitive Devices (ESD). Observe precautions for handling! Failure to observe these precautions can result in severe damage to the GPS receiver!**

GPS 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 ~10pF, coax cable ~50-80pF/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<br>Configured to transmit both NMEA and UBX protocols, but only following NMEA and no UBX messages have been activated at start-up:<br><b>GGA, GLL, GSA, GSV, RMC, TTG, TXT</b>         |
| USB Output             | Configured to transmit both NMEA and UBX protocols, but only following NMEA and no UBX messages have been activated at start-up:<br><b>GGA, GLL, GSA, GSV, RMC, TTG, TXT</b><br>USB Power Mode: Bus Powered                          |
| UART Input             | 9600 Baud, 8 bits, no parity bit, 1 stop bit, Autobauding disabled<br>Automatically accepts following protocols without need of explicit configuration:<br>UBX, NMEA<br>The GPS receiver supports interleaved UBX and NMEA messages. |
| USB Input              | Automatically accepts following protocols without need of explicit configuration:<br>UBX, NMEA<br>The GPS receiver supports interleaved UBX and NMEA messages.<br>USB Power Mode: Bus Powered  |
| TIMEPULSE<br>(1Hz Nav) | 1 pulse per second, synchronized at rising edge, pulse length 100ms  |

**Table 12: Default messages**



Refer to the *u-blox 7 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 7 GPS modules includes important product information. The location of the product type number is shown in Figure 6.

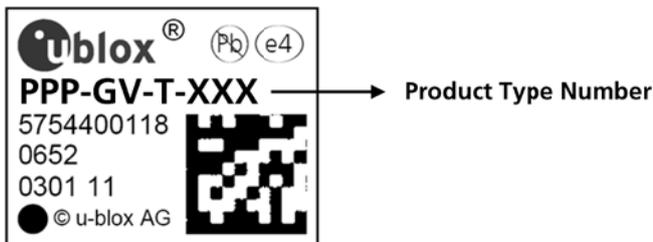


Figure 6: Location of product type number on u-blox 7 module label

### 9.2 Explanation of codes

3 different product code formats are used. The **Product Name** is used in documentation such as this data sheet and identifies all u-blox 7 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 below details these 3 different formats:

| Format        | Structure    |
|---------------|--------------|
| Product Name  | PPP-GV       |
| Ordering Code | PPP-GV-T     |
| Type Number   | PPP-GV-T-XXX |

Table 13: Product Code Formats

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

| Code | Meaning                | Example  |
|------|------------------------|--|
| PPP  | Product Family         | NEO  |
| G    | Product Generation     | 7 = u-blox7  |
| V    | Variant                | T = Timing, R = DR, etc.   |
| T    | Option / Quality Grade | Describes standardized functional element or quality grade such as Flash size, automotive grade etc. |
| XXX  | 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-7M-0     | u-blox 7 GPS/GNSS Module, ROM, 12x16mm, 250 pcs/reel                   |
| NEO-7N-0     | u-blox 7 GPS/GNSS Module, Flash, TCXO, SAW, LNA, 12x16mm, 250 pcs/reel |

Table 15: Product ordering codes for standard 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] MAX-7 / NEO-7 / LEA-7 Hardware Integration Manual, Docu. No. GPS.G7-HW-11006
- [2] u-blox 7 Receiver Description including Protocol Specification, Docu. No GPS.G7-SW-12001
- [3] u-blox Package Information Guide, Docu. No. GPS-X-11004

For complete contact information visit us at [www.u-blox.com](http://www.u-blox.com)

## Revision history

| Revision | Date          | Name      | Status / Comments                       |
|----------|---------------|-----------|---|
| -        | Aug. 28, 2012 | dhur/cbib | Initial release                         |
| 1        | Feb. 18, 2013 | Dhur/cbib | Updated section 1.5. Corrected table 6. |

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