



# MAX-M10S

**Standard precision GNSS module**

**Professional grade**

Data sheet



## **Abstract**

This data sheet describes the MAX-M10S module, an ultra-low-power GNSS receiver for high-performance asset-tracking applications.

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# Document information

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This document applies to the following products:

| <b>Product name</b> | <b>Type number</b> | <b>FW version</b> | <b>IN/PCN reference</b> | <b>Product status</b> |
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| MAX-M10S            | MAX-M10S-00B-01    | ROM SPG 5.10      | UBX-22012689            | Initial production    |

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# 1 Functional description

## 1.1 Overview

MAX-M10S module features the u-blox M10 standard precision GNSS platform and provides exceptional sensitivity and acquisition time for all L1 GNSS signals.

The M10 platform supports concurrent reception of four GNSS (GPS, GLONASS, Galileo, and BeiDou). The high number of visible satellites enables the receiver to select the best signals. This maximizes the position availability, in particular under challenging conditions such as in deep urban canyons.

u-blox Super-S (Super-Signal) technology offers great RF sensitivity and can improve the dynamic position accuracy with small antennas or in non-line-of-sight scenarios.

The extremely low power consumption of 25 mW in continuous tracking mode allows great power autonomy for all battery-operated devices, such as asset trackers, without compromising on GNSS performance.

For maximum sensitivity in passive antenna designs, MAX-M10S integrates an LNA followed by a SAW filter in the RF path.

MAX-M10S offers backwards pin-to-pin compatibility with products from the previous u-blox generations, which saves the designer's effort and reduces costs when upgrading designs to the advanced low-power u-blox M10 GNSS technology.

## 1.2 Performance

| Parameter                             | Specification | Value   |
|---------------------------------------|---------------|---|
| Receiver type                         |               | u-blox M10 receiver                           |
| Accuracy of time pulse signal         | RMS           | 30 ns   |
|                                       | 99%           | 60 ns   |
| Frequency of time pulse signal        |               | Default 1PPS (0.25 Hz to 10 MHz configurable) |
| Operational limits <sup>1</sup>       | Dynamics      | ≤ 4 g   |
|                                       | Altitude      | 80,000 m                                      |
|                                       | Velocity      | 500 m/s                                       |
| Velocity accuracy <sup>2</sup>        |               | 0.05 m/s                                      |
| Dynamic heading accuracy <sup>2</sup> |               | 0.3 deg                                       |

**Table 1: MAX-M10S specifications**

| Parameter |                               | GPS+GAL                                 | GPS+GAL<br>+GLO | GPS+GAL<br>+BDS B1I<br>(default) | GPS+GAL<br>+BDS B1C | GPS+GAL<br>+BDS B1C<br>+GLO |
|-----------|-------------------------------|---|-----------------|----------------------------------|---------------------|-----------------------------|
|           |                               | Max navigation update rate <sup>3</sup> | Default         | 10 Hz                            | 6 Hz                | 3 Hz                        |
|           | High performance <sup>4</sup> | 20 Hz                                   | 16 Hz           | 12 Hz                            | 16 Hz               | 10 Hz                       |

<sup>1</sup> Assuming Airborne 4 g platform.

<sup>2</sup> 50% at 30 m/s for dynamic operation.

<sup>3</sup> Minimum 98% fix rate under typical conditions.

<sup>4</sup> Configuration required.

| Parameter                                   |                                    | GPS+GAL  | GPS+GAL<br>+GLO | GPS+GAL<br>+BDS B1I<br>(default) | GPS+GAL<br>+BDS B1C | GPS+GAL<br>+BDS B1C<br>+GLO |
|---|------------------------------------|----------|-----------------|----------------------------------|---------------------|-----------------------------|
| Position accuracy (CEP) <sup>5, 6</sup>     |                                    | 1.5 m    | 1.5 m           | 1.5 m                            | 1.5 m               | 1.5 m                       |
| Time To First Fix (TTFF) <sup>5, 7, 8</sup> | Cold start                         | 28 s     | 23 s            | 27 s                             | 28 s                | 23 s                        |
|   | Hot start                          | 1 s      | 1 s             | 1 s                              | 1 s                 | 1 s                         |
|   | AssistNow Online <sup>9</sup>      | 1 s      | 1 s             | 1 s                              | 1 s                 | 1 s                         |
|   | AssistNow Offline <sup>10</sup>    | 2 s      | 2 s             | 3 s                              | 2 s                 | 2 s                         |
|   | AssistNow Autonomous <sup>11</sup> | 3 s      | 4 s             | 4 s                              | 4 s                 | 4 s                         |
| Sensitivity <sup>12</sup>                   | Tracking and nav.                  | -167 dBm | -167 dBm        | -167 dBm                         | -167 dBm            | -167 dBm                    |
|   | Reacquisition                      | -160 dBm | -160 dBm        | -160 dBm                         | -160 dBm            | -160 dBm                    |
|   | Cold Start                         | -148 dBm | -148 dBm        | -148 dBm                         | -148 dBm            | -148 dBm                    |
|   | Hot start <sup>7</sup>             | -159 dBm | -159 dBm        | -159 dBm                         | -159 dBm            | -159 dBm                    |

**Table 2: MAX-M10S typical performance in multi-constellation GNSS modes.**

| Parameter                                   |                               | GPS      | GLONASS  | BDS B1I  | GALILEO  | BDS B1C  |
|---|-------------------------------|----------|----------|----------|----------|----------|
| Max navigation update rate <sup>3</sup>     | Default                       | 18 Hz    | 18 Hz    | 18 Hz    | 18 Hz    | 18 Hz    |
|   | High performance <sup>4</sup> | 25 Hz    | 25 Hz    | 25 Hz    | 25 Hz    | 25 Hz    |
| Position accuracy (CEP) <sup>5, 6</sup>     |                               | 1.5 m    | 4 m      | 2 m      | 3 m      | 2 m      |
| Time To First Fix (TTFF) <sup>5, 7, 8</sup> | Cold start                    | 29 s     | 27 s     | 30 s     | 41 s     | 56 s     |
|   | Hot start                     | 1 s      | 1 s      | 1 s      | 1 s      | 1 s      |
|   | AssistNow Online <sup>9</sup> | 1 s      | 1 s      | 1 s      | 5 s      | N/A      |
| Sensitivity <sup>12</sup>                   | Tracking and nav.             | -167 dBm | -166 dBm | -160 dBm | -161 dBm | -163 dBm |
|   | Reacquisition                 | -160 dBm | -158 dBm | -158 dBm | -154 dBm | -156 dBm |
|   | Cold Start                    | -148 dBm | -147 dBm | -146 dBm | -141 dBm | -136 dBm |
|   | Hot start <sup>7</sup>        | -159 dBm | -159 dBm | -159 dBm | -155 dBm | -157 dBm |

**Table 3: MAX-M10S typical performance in single-GNSS modes**

### 1.3 Supported GNSS constellations

MAX-M10S is a concurrent GNSS receiver that can receive and track multiple GNSS systems. The single RF front-end architecture enables concurrent reception of multiple GNSS constellations. The receiver can be configured for a subset of GNSS constellations to achieve lower power consumption.

The default configuration on MAX-M10S is concurrent reception of GPS, Galileo, and BeiDou B1I with QZSS and SBAS enabled.

The following GNSS and their signals are supported:

<sup>5</sup> GPS is always in combination with SBAS and QZSS.

<sup>6</sup> CEP, 50%, 24 hours static, -130 dBm, > 6 SVs for each GNSS system

<sup>7</sup> Commanded starts.

<sup>8</sup> All satellites at -130 dBm. Measured at room temperature.

<sup>9</sup> Dependent on the speed and latency of the aiding data connection, commanded starts.

<sup>10</sup> Using seven days old AssistNow Offline data. External memory may be required.

<sup>11</sup> Using two days old orbital predicted data. External memory may be required.

<sup>12</sup> Demonstrated with a good external LNA. Measured at room temperature.

| System               | Signals   |
|----------------------|---|
| GPS / QZSS           | L1C/A (1575.42 MHz)   |
| Galileo              | E1-B/C (1575.42 MHz)  |
| GLONASS              | L1OF (1602 MHz + $k \cdot 562.5$ kHz, $k = -7, \dots, 5, 6$ ) |
| BeiDou <sup>13</sup> | B1I (1561.098 MHz), B1C (1575.42 MHz)                         |

**Table 4: Supported GNSS and signals on MAX-M10S**

The following GNSS assistance services are supported:

| Service               | Support   |
|-----------------------|---|
| AssistNow™ Online     | GPS L1C/A, QZSS L1C/A, Galileo E1, GLONASS L1OF, BeiDou B1I |
| AssistNow™ Offline    | GPS L1C/A, GLONASS L1OF                                     |
| AssistNow™ Autonomous | GPS L1C/A, QZSS L1C/A, Galileo E1, GLONASS L1OF, BeiDou B1I |

**Table 5: Supported Assisted GNSS (A-GNSS) services**

The following augmentation systems are supported:

| System | Support                     |
|--------|-----------------------------|
| SBAS   | EGNOS, GAGAN, MSAS and WAAS |
| QZSS   | L1S (SLAS)                  |

**Table 6: Supported augmentation systems**

The augmentation systems SBAS and QZSS can be enabled only if GPS operation is also enabled.

## 1.4 Supported protocols

MAX-M10S supports the following interface protocols:

| Protocol  | Type                                     |
|---|--|
| UBX   | Input/output, binary, u-blox proprietary |
| NMEA versions 2.1, 2.3, 4.0, 4.10 and 4.11 (default). | Input/output, ASCII                      |

**Table 7: Supported protocols**

## 1.5 Firmware features

| Feature                          | Description  |
|----------------------------------|--|
| Antenna supervisor <sup>14</sup> | Antenna supervisor for active antenna control and short detection                          |
| CloudLocate GNSS                 | Extends the life of energy-constrained IoT applications. Small payload messages supported. |
| Assisted GNSS                    | AssistNow Online, AssistNow Offline and AssistNow Autonomous                               |
| Backup modes                     | Hardware backup mode and software standby mode   |
| Power save modes <sup>15</sup>   | On/off, cyclic tracking  |
| Super-S                          | Improved dynamic position accuracy with small antennas                                     |

<sup>13</sup> BeiDou B1I cannot be enabled simultaneously with BeiDou B1C or GLONASS L1OF.

<sup>14</sup> External components required, some pins need to be reconfigured.

<sup>15</sup> The power save modes are not available if BeiDou B1C is enabled.

| Feature                      | Description   |
|------------------------------|---|
| Protection level             | Real-time position accuracy estimate with 95% confidence level <sup>16</sup>            |
| Galileo return link messages | Galileo search and rescue (SAR) return link messages (RLM) via Galileo satellite signal |
| Data batching                | Autonomous tracking up to 10 minutes at 1 Hz  |
| Odometer                     | Measure traveled distance with support for different user profiles                      |

**Table 8: Firmware features**

| Feature                | Description   |
|------------------------|---|
| Anti-jamming           | RF interference and jamming detection and reporting |
| Anti-spoofing          | Spoofing detection and reporting                    |
| Configuration lockdown | Receiver configuration can be locked by command     |
| Message integrity      | All messages can be cryptographically signed        |
| Secure boot            | Only signed firmware images executed                |

**Table 9: Security features**

<sup>16</sup> Verified for automotive environment only.

## 2 System description

### 2.1 Block diagram

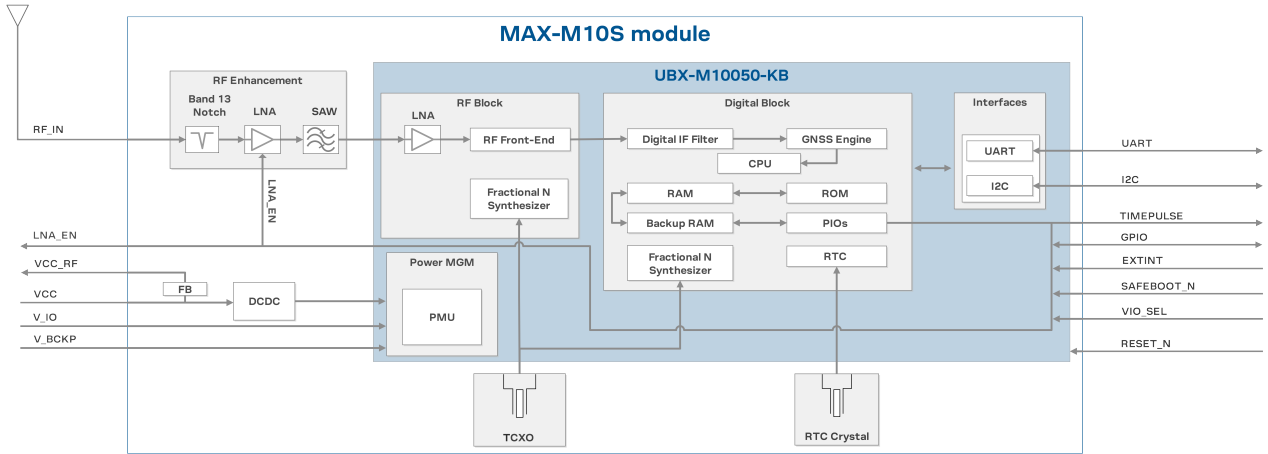


Figure 1: MAX-M10S block diagram



## 3 Pin definition

### 3.1 Pin assignment

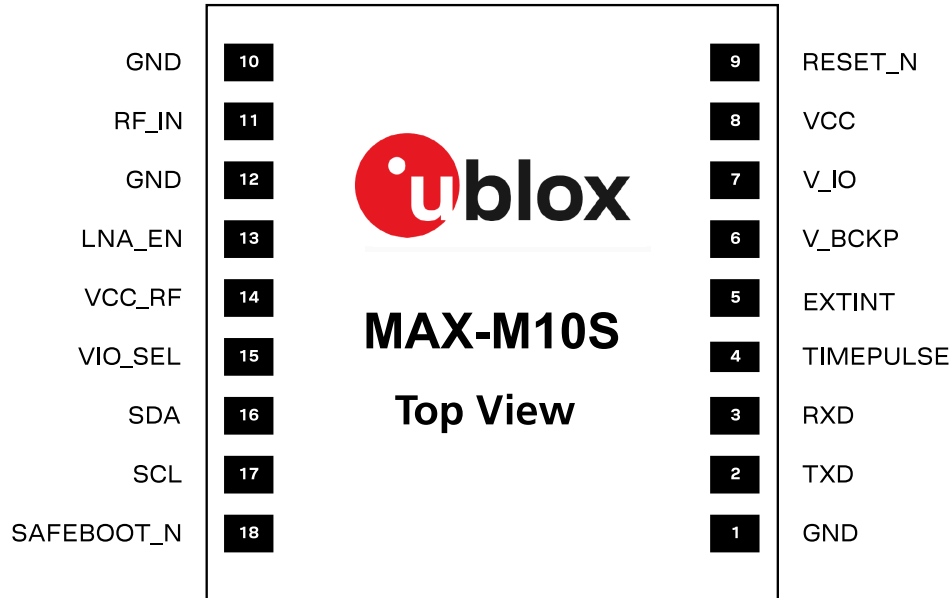


Figure 2: MAX-M10S pin assignment

| Pin no. | Name       | PIO no. | I/O | Description  |
|---------|------------|---------|-----|--|
| 1       | GND        | -       | -   | Connect to GND   |
| 2       | TXD        | 1       | O   | UART TX  |
| 3       | RXD        | 0       | I   | UART RX  |
| 4       | TIMEPULSE  | 4       | O   | Time pulse signal (shared with SAFEBOOT_N pin) <sup>17</sup>                                       |
| 5       | EXTINT     | 5       | I   | External interrupt   |
| 6       | V_BCKP     | -       | I   | Backup voltage supply  |
| 7       | V_IO       | -       | I   | IO voltage supply  |
| 8       | VCC        | -       | I   | Main voltage supply  |
| 9       | RESET_N    | -       | I   | System reset (active low). Has to be low for at least 1 ms to trigger a reset.                     |
| 10      | GND        | -       | -   | Connect to GND   |
| 11      | RF_IN      | -       | I   | GNSS signal input  |
| 12      | GND        | -       | -   | Connect to GND   |
| 13      | LNA_EN     | -       | O   | On/Off external LNA or active antenna  |
| 14      | VCC_RF     | -       | O   | Output voltage RF section  |
| 15      | VIO_SEL    | -       | I   | Voltage selector for V_IO supply. Connect to GND for 1.8 V supply, or leave open for 3.3 V supply. |
| 16      | SDA        | 2       | I/O | I2C data   |
| 17      | SCL        | 3       | I   | I2C clock  |
| 18      | SAFEBOOT_N | -       | I   | Safeboot mode (leave open) <sup>17</sup>   |

Table 10: MAX-M10S pin assignment

<sup>17</sup> The receiver enters safeboot mode if this pin is low at start up. The SAFEBOOT\_N pin is internally connected to TIMEPULSE pin through a 1 kΩ series resistor.

## 3.2 Pin state

Table 11 defines the state of the PIOs and RESET\_N pins in different modes. The functions of the PIOs are as defined in the default configuration.

| PIO no. | Pin no. | Default function | Continuous mode | Software standby mode | Safe boot mode |
|---------|---------|------------------|-----------------|-----------------------|----------------|
| 0       | 3       | RXD              | Input pull-up   | Input pull-up         | Input pull-up  |
| 1       | 2       | TXD              | Output          | Input pull-up         | Output         |
| 2       | 16      | SDA              | Input pull-up   | Input pull-up         | Input pull-up  |
| 3       | 17      | SCL              | Input pull-up   | Input pull-up         | Input pull-up  |
| 4       | 18      | SAFEBOOT_N       | Output          | Input pull-down       | High Z         |
|         | 4       | TIMEPULSE        | Output          | Input pull-down       | High Z         |

**Table 11: Pins state**



In reset mode (RESET\_N = low), all PIOs are configured as input pull-up.



In hardware backup mode (VCC = 0 V and V\_IO = 0 V), PIOs must not be driven.

## 4 Electrical specifications

**CAUTION** Operating the device above one or more of the limiting values may cause permanent damage to the device. The values provided in this chapter are stress ratings. Extended exposure to the values outside the limits may effect the device reliability.

Where application information is given, it is advisory only and does not form part of the specification.

### 4.1 Absolute maximum ratings

| Symbol            | Parameter   | Min  | Max                                 | Unit |
|-------------------|---|------|-------------------------------------|------|
| VCC               | Main supply voltage   | -0.3 | 3.6                                 | V    |
| V <sub>IO</sub>   | IO supply voltage   | -0.3 | VCC + 0.3<br>(max 3.6)              | V    |
|                   | Voltage ramp on V <sub>IO</sub> <sup>18</sup>                 | 25   | 35000                               | μs/V |
| V <sub>BCKP</sub> | Backup supply voltage   | -0.3 | 3.6                                 | V    |
| V <sub>PIO</sub>  | Input voltage on RESET_N and digital pins.<br>VIO_SEL = GND.  | -0.3 | V <sub>IO</sub> + 0.3<br>(max 1.98) | V    |
|                   | Input voltage on RESET_N and digital pins.<br>VIO_SEL = open. | -0.3 | V <sub>IO</sub> + 0.3<br>(max 3.6)  | V    |
| I <sub>PIO</sub>  | Max source / sink current, digital pins <sup>19</sup>         | -10  | 10                                  | mA   |
| ICC <sub>RF</sub> | Max source current, VCC <sub>RF</sub>                         |      | 250                                 | mA   |
| P <sub>rfin</sub> | RF input power on RF_IN <sup>20</sup>                         |      | 0                                   | dBm  |
| T <sub>amb</sub>  | Ambient temperature   | -40  | +85                                 | °C   |
| T <sub>s</sub>    | Storage temperature   | -40  | +85                                 | °C   |

**Table 12: Absolute maximum ratings**

V<sub>IO</sub> supply voltage must not be higher than VCC + 0.3 V.

The product is not protected against overvoltage or reversed voltages. Voltage spikes exceeding the power supply voltage specification, given in the table above, must be limited to values within the specified boundaries by using appropriate protection diodes.

### 4.2 Operating conditions

Table 13 shows the general operating conditions. Table 14 shows the electrical parameters for digital I/O.

The V<sub>IO</sub> voltage range is selected with the VIO\_SEL pin.

For designs with 1.8 V supply at V<sub>IO</sub> and V<sub>BCKP</sub> supplied, switch off V<sub>IO</sub> supply 100 ms before VCC when transitioning to hardware backup mode. Alternatively, put the receiver to software standby mode by sending UBX-RXM-PMREQ message before switching off V<sub>IO</sub> and VCC. For designs with 3 V supplies, both supplies can be switched off simultaneously or ensure that V<sub>IO</sub> is switched off before VCC.

<sup>18</sup> Exceeding the voltage ramp speed may permanently damage the device.

<sup>19</sup> The SAFEBOOT\_N pin has an internal 1 kΩ series resistor.

<sup>20</sup> Test conditions: source impedance = 50 Ω, continuous wave.

| Symbol                 | Parameter  | Min  | Typical   | Max            | Unit |
|------------------------|--|------|-----------|----------------|------|
| VCC                    | Main supply voltage  | 1.76 | 1.8, 3.3  | 3.6            | V    |
| V <sub>IO</sub>        | IO supply voltage, V <sub>IO_SEL</sub> = GND   | 1.76 | 1.8       | VCC (max 1.98) | V    |
|                        | IO supply voltage, V <sub>IO_SEL</sub> = open  | 2.7  | 3.3       | VCC (max 3.6)  | V    |
| V <sub>BCKP</sub>      | Supply voltage, backup domain  | 1.65 |           | 3.6            | V    |
| V <sub>IOSWITCH</sub>  | V <sub>IO</sub> voltage threshold to switch an internal supply for the backup domain from V <sub>IO</sub> to V <sub>BCKP</sub> |      | 1.45      |                | V    |
| VCC <sub>RF</sub>      | VCC <sub>RF</sub> output voltage   |      | VCC - 0.1 |                | V    |
| ICC <sub>RF</sub>      | VCC <sub>RF</sub> output current   |      |           | 50             | mA   |
| NF <sub>tot</sub>      | Receiver chain noise figure  |      | 1.5       |                | dB   |
| Ext_gain <sup>21</sup> | External gain at RF_IN, low gain mode (default)  |      |           | 30             | dB   |
|                        | External gain at RF_IN, bypass mode  | 10   | 25        | 40             | dB   |
| T <sub>opr</sub>       | Operating temperature  | -40  |           | +85            | °C   |

**Table 13: General operating conditions**

| Symbol                      | Parameter   | Min                    | Typical | Max             | Unit |
|-----------------------------|---|------------------------|---------|-----------------|------|
| I <sub>leak</sub>           | Leakage current input pins <sup>22</sup>                                  |                        | 25      |                 | nA   |
| V <sub>in</sub>             | Input pin voltage range   | 0                      |         | V <sub>IO</sub> | V    |
| V <sub>il</sub>             | Low-level input voltage   |                        |         | 0.63            | V    |
| V <sub>ih</sub>             | High-level input voltage  | 0.68 x V <sub>IO</sub> |         |                 | V    |
| V <sub>ol</sub>             | Low-level output voltage, I <sub>out</sub> = -2 mA <sup>23</sup>          |                        |         | 0.4             | V    |
| V <sub>oh</sub>             | High-level output voltage, I <sub>out</sub> = 2 mA <sup>23</sup>          | V <sub>IO</sub> - 0.4  |         |                 | V    |
| R <sub>pu, IO</sub>         | Pull-up resistance, Digital IO <sup>24</sup> . V <sub>IO_SEL</sub> = GND  | 6                      | 17      | 72              | kΩ   |
| R <sub>pu, IO</sub>         | Pull-up resistance, Digital IO <sup>24</sup> . V <sub>IO_SEL</sub> = open | 8                      | 18      | 40              | kΩ   |
| R <sub>pd, IO</sub>         | Pull-down resistance, Digital IO  | 21                     | 80      | 180             | kΩ   |
| R <sub>pu, SAFEBOOT_N</sub> | Pull-up resistance, SAFEBOOT_N <sup>25</sup>                              | 6                      | 17      | 72              | kΩ   |
| R <sub>pu, RESET_N</sub>    | Pull-up resistance, RESET_N   | 7                      | 10      | 13              | kΩ   |

**Table 14: Digital IO**


Operation beyond the specified operating conditions can affect device reliability.

### 4.3 Indicative power requirements

Table 15 shows indicative current consumption for VCC and V<sub>IO</sub> with a 3.0 V supply.

<sup>21</sup> The internal LNA gain is configurable.

<sup>22</sup> V<sub>in</sub> = V<sub>IO</sub>, at room temperature.

<sup>23</sup> TIMEPULSE (PIO4) has 4 mA current drive/sink capability.

<sup>24</sup> TXD, RXD, TIMEPULSE, EXTINT, SCL, SDA, and LNA\_EN.

<sup>25</sup> The SAFEBOOT\_N pin has an additional 1 kΩ series resistor.

| Symbol (Parameter)  | Conditions                                    | GPS | GPS+GAL | GPS+GAL +GLO | GPS+GAL +BDS B1I (default) | GPS+GAL +BDS B1C | GPS+GAL +BDS B1C +GLO | Unit |
|---|---|-----|---------|--------------|----------------------------|------------------|-----------------------|------|
| $I_{VCC}$ <sup>26, 27</sup><br>(Current at VCC)             | Acquisition <sup>28</sup>                     | 8   | 10      | 12           | 11.5                       | 11               | 13                    | mA   |
|   | Tracking<br>(Continuous mode)                 | 7.5 | 8       | 9            | 9.5                        | 8.5              | 10                    | mA   |
|   | Tracking<br>(Power save mode) <sup>29</sup>   | 4.5 | 5       | 5            | 5                          | -                | -                     | mA   |
| $I_{V_{IO}}$ <sup>26</sup><br>(Current at V <sub>IO</sub> ) | Acquisition and Tracking<br>(Continuous mode) | 2.1 | 2.2     | 2.3          | 2.3                        | 2.2              | 2.3                   | mA   |
|   | Tracking                                      | 2   | 2       | 2            | 2                          | -                | -                     | mA   |
|   | Tracking<br>(Power save mode) <sup>29</sup>   | 2   | 2       | 2            | 2                          | -                | -                     | mA   |

**Table 15: Typical currents for 3.0 V supply at VCC and V<sub>IO</sub>**

Table 16 shows indicative current consumption for VCC and V<sub>IO</sub> with a 1.8 V supply.

| Symbol (Parameter)  | Conditions                                    | GPS  | GPS+GAL | GPS+GAL +GLO | GPS+GAL +BDS B1I (default) | GPS+GAL +BDS B1C | GPS+GAL +BDS B1C +GLO | Unit |
|---|---|------|---------|--------------|----------------------------|------------------|-----------------------|------|
| $I_{VCC}$ <sup>26, 27</sup><br>(Current at VCC)             | Acquisition <sup>28</sup>                     | 10.5 | 15.5    | 17.5         | 16.5                       | 16               | 18.5                  | mA   |
|   | Tracking<br>(Continuous mode)                 | 9.5  | 11      | 12.5         | 13                         | 11.5             | 14                    | mA   |
|   | Tracking<br>(Power save mode) <sup>29</sup>   | 5.5  | 6.0     | 6.5          | 6.5                        | -                | -                     | mA   |
| $I_{V_{IO}}$ <sup>26</sup><br>(Current at V <sub>IO</sub> ) | Acquisition and Tracking<br>(Continuous mode) | 2.1  | 2.1     | 2.2          | 2.2                        | 2.1              | 2.2                   | mA   |
|   | Tracking                                      | 2    | 2       | 2            | 2                          | -                | -                     | mA   |
|   | Tracking<br>(Power save mode) <sup>29</sup>   | 2    | 2       | 2            | 2                          | -                | -                     | mA   |

**Table 16: Typical currents for 1.8 V supply at VCC and V<sub>IO</sub>**


These values are provided for customer information only, as an example of typical current requirements. They are characterized on samples using a cold start command. Actual power requirements can vary depending on firmware version used, external circuitry, number of satellites tracked, signal strength, type and time of start, duration, internal LNA gain mode, and test conditions.



The inrush current at startup can go up to 100 mA. Ensure that the external power supply is able to deliver up to 100 mA.

Table 17 shows current consumptions for the backup modes.

| Symbol                       | Parameter                                 | Conditions  | Typ. | Unit          |
|------------------------------|---|---|------|---------------|
| $I_{V_{BCKP}}$ <sup>30</sup> | Total current in hardware backup mode     | $V_{BCKP} = 3.3\text{ V}$ , $V_{IO} = VCC = 0\text{ V}$ | 28   | $\mu\text{A}$ |
| $I_{V_{IO}}$                 | $V_{IO}$ current in software standby mode | $V_{IO} = 1.8\text{ V}$                                 | 37   | $\mu\text{A}$ |
|                              |   | $V_{IO} = 3.3\text{ V}$                                 | 46   | $\mu\text{A}$ |

<sup>26</sup> 1 Hz navigation update rate.

<sup>27</sup> Internal LNA set to low gain. Simulated signal using power levels of -130 dBm.

<sup>28</sup> Average current from start-up until the first fix.

<sup>29</sup> Cyclic tracking operation. BeiDou B1C is not supported in this mode.

<sup>30</sup>  $I_{V_{BCKP}}$  current in normal operation ( $V_{BCKP} = 3.3\text{ V}$ ,  $V_{IO} = VCC = 3.3\text{ V}$ ) is  $\sim 3\text{ }\mu\text{A}$ .

| Symbol    | Parameter                            | Conditions  | Typ. | Unit |
|-----------|--------------------------------------|-------------|------|------|
| $I_{VCC}$ | VCC current in software standby mode | VCC = 3.3 V | 120  | nA   |

**Table 17: Backup currents**

All values in [Table 15](#), [Table 16](#), and [Table 17](#) are measured at 25 °C ambient temperature and with the internal LNA set to low gain. SBAS and QZSS are activated in all measurements.

## 5 Communication interfaces

The receiver supports communication over UART and I2C interfaces.

All the inputs have an internal pull-up resistor in normal operation and can be left open if not used. The voltage level at the PIO pins is related to the V<sub>IO</sub> supply voltage.

### 5.1 UART

The UART interface supports configurable baud rates. Hardware flow control is not supported. UART specifications are described in [Table 18](#).

| Symbol          | Parameter              | Min   | Max    | Unit  |
|-----------------|------------------------|-------|--------|-------|
| R <sub>u</sub>  | Baud rate              | 4800  | 921600 | bit/s |
| Δ <sub>Tx</sub> | Tx baud rate accuracy  | -1%   | +1%    | -     |
| Δ <sub>Rx</sub> | Rx baud rate tolerance | -2.5% | +2.5%  | -     |

**Table 18: UART specifications**

### 5.2 I2C

An I2C interface is available for communication with an external host CPU in I2C Fast-mode. Backwards compatibility with Standard-mode I2C bus operation is not supported. The interface can be operated only in slave mode with a maximum bit rate of 400 kbit/s<sup>31</sup>.

The interface can make use of clock stretching by holding the SCL line LOW to pause a transaction. In this case, the bit transfer rate is reduced. The maximum clock stretching time is 20 ms.

### 5.3 Default interface settings

| Interface | Settings   |
|-----------|--|
| UART      | <ul style="list-style-type: none"> <li>9600 baud, 8 bits, no parity bit, 1 stop bit.</li> <li>Input messages: NMEA and UBX.</li> <li>Output messages: NMEA GGA, GLL, GSA, GSV<sup>32</sup>, RMC, VTG and TXT.</li> </ul> |
| I2C       | <ul style="list-style-type: none"> <li>7-bit I2C address (0x42).</li> <li>Input messages: NMEA and UBX.</li> <li>Output messages: NMEA GGA, GLL, GSA, GSV<sup>32</sup>, RMC, VTG and TXT.</li> </ul>                     |

**Table 19: Default interface settings**

<sup>31</sup> External pull-up resistors may be needed to achieve 400 kbit/s communication speed, as the internal pull-up resistance can be very large.

<sup>32</sup> In the default configuration, the NMEA-GSV messages are sent at 5-second intervals to avoid overflow in the TX buffer.

## 6 Mechanical specifications

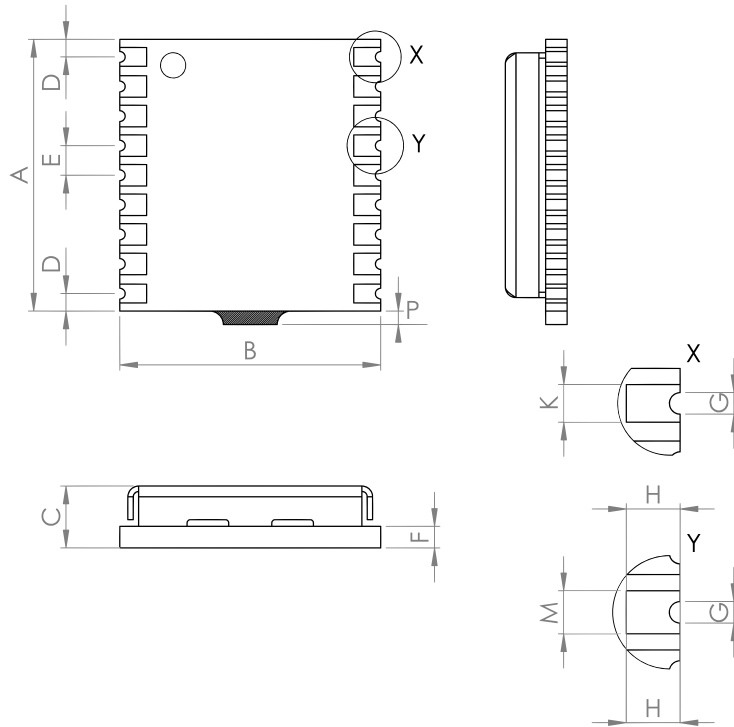


Figure 3: MAX-M10S mechanical drawing

| Symbol | Min (mm) | Typical (mm) | Max (mm) |
|--------|----------|--------------|----------|
| A      | 10.0     | 10.1         | 10.7     |
| B      | 9.6      | 9.7          | 9.8      |
| C      | 2.2      | 2.5          | 2.7      |
| D      | 0.55     | 0.65         | 0.95     |
| E      | 1.0      | 1.1          | 1.2      |
| F      | -        | 0.76         | -        |
| G      | 0.3      | 0.4          | 0.5      |
| H      | 0.9      | 1.0          | 1.1      |
| K      | 0.6      | 0.7          | 0.8      |
| M      | 0.7      | 0.8          | 0.9      |
| P      | 0.0      | 0.3          | 0.6      |
| Weight |          | 0.6 g        |          |

Table 20: MAX-M10S mechanical dimensions



The mechanical picture of the de-paneling residual tab (P) is an approximate representation, shape and position may vary.



## 7 Approvals

The MAX-M10S is designed for the presumption of conformity with the essential requirements and other relevant provisions of Radio Equipment Directive (RED) 2014/53/EU.

The MAX-M10S complies with the Directive 2011/65/EU (EU RoHS 2) and its amendment Directive (EU) 2015/863 (EU RoHS 3).

The Declaration of Conformity (DoC) is available at [u-blox website](#) within Support > File Category > Conformity and Certification .

## 8 Product handling

### 8.1 Moisture sensitivity level

The moisture sensitivity level (MSL) relates to the packaging and handling precautions required. MAX-M10S LCC (professional grade) package is rated at MSL level 4. For MSL standard, see IPC/JEDEC J-STD-020 [5].

## 9 Labeling and ordering information

This section provides information about product labeling and ordering.

### 9.1 Product labeling

The labeling of MAX-M10S package provides product information and revision information. For more information contact u-blox sales.

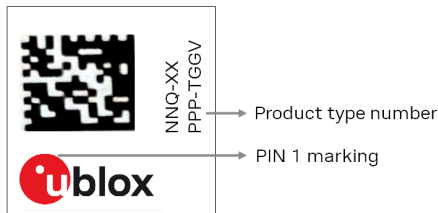


Figure 4: MAX-M10S label

The parts of the product code are explained in [Table 21](#)

| Code | Meaning        | Example  |
|------|----------------|--|
| PPP  | Product family | MAX  |
| TGG  | Platform       | M10 = u-blox M10                                       |
| V    | Variant        | S = Standard precision, ROM, TCXO, LNA, and SAW filter |
| NN   | Option         | 00, 01, 02, ...  |
| Q    | Quality grade  | A = Automotive, B = Professional                       |
| XX   | Product detail | Describes hardware and firmware versions               |

Table 21: Part identification code

### 9.2 Explanation of product codes

Three product code formats are used. The product name is used in documentation such as this data sheet and identifies all u-blox 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 22](#) details these three different formats for MAX-M10S module.

| Format        | Structure       | Product code    |
|---------------|-----------------|-----------------|
| Product name  | PPP-TGGV        | MAX-M10S        |
| Ordering code | PPP-TGGV-NNQ    | MAX-M10S-00B    |
| Type number   | PPP-TGGV-NNQ-XX | MAX-M10S-00B-01 |

Table 22: Product code formats

### 9.3 Ordering codes

| Ordering code | Product   | Remark |
|---------------|---|--------|
| MAX-M10S-00B  | u-blox M10 GNSS receiver module, professional grade |        |

Table 23: Product ordering codes



Product changes affecting form, fit or function are documented by u-blox. For a list of Product Change Notifications (PCNs) see our website at: <https://www.u-blox.com/en/product-resources>.

## Related documents

- [1] MAX-M10S Integration manual, [UBX-20053088](#)
- [2] u-blox M10 SPG 5.10 Interface description, [UBX-21035062](#)
- [3] u-blox M10 SPG 5.10 Release notes, [UBX-22001426](#)
- [4] u-blox Package Information Guide, [UBX-14001652](#)
- [5] MSL standard IPC/JEDEC J-STD-020, [www.jedec.org](http://www.jedec.org)



For regular updates to u-blox documentation and to receive product change notifications please register on our homepage <https://www.u-blox.com>.

## Revision history

| Revision | Date        | Name                   | Status / comments   |
|----------|-------------|------------------------|---|
| R01      | 21-Dec-2020 | imar, jesk, msul, rmak | Objective specification   |
| R02      | 20-Apr-2021 | rmak                   | Advance information. Updated Firmware features, Pin assignment, Absolute maximum ratings, Operating conditions, Indicative power requirements, and Product labeling. Minor revision.  |
| R03      | 28-Jun-2022 | imar, oola             | New product type number for MAX-M10S-00B-01 with ROM SPG 5.10 firmware. Updated Document information, Pin definition, Performance figures and Indicative power requirements with new GNSS configurations. Updated Electrical specifications, Operating conditions, and Absolute maximum ratings.<br>Added configuration lock and power save modes features, maximum I2C clock stretching time, MSL specification and Reliability tests and approvals. |
| R04      | 16-May-2023 | oola                   | Updated maximum navigation update rate in section Performance, ICC_RF in section Absolute maximum ratings, VCC and V_IO supply timing requirements in Operating conditions, and section Mechanical specifications. Added 1 Hz navigation update rate footnote in section Indicative power requirements.   |

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