# MIA-M10C

## Standard precision GNSS modules

### Professional grade

Data sheet

**Abstract**

This data sheet describes MIA-M10C, an ultra-small form factor and ultra-low-power GNSS receiver compatible with external active antennas for asset tracking applications.

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# Document information

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| Product status | Corresponding content status | |
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| **Functional Sample** | Draft | For functional testing. Revised and supplementary data will be published later. |
| **In development / prototype** | Objective specification | Target values. Revised and supplementary data will be published later. |
| **Engineering sample** | Advance information | Data based on early testing. Revised and supplementary data will be published later. |
| **Initial production** | Early production information | Data from product verification. Revised and supplementary data may be published later. |
| **Mass production / End of life** | Production information | Document contains the final product specification. |

This document applies to the following products:

| Product name | Type number | FW version | IN/PCN reference | Product status |
|---|---|---|---|---|
| MIA-M10C | MIA-M10C-00B-01 | ROM SPG 5.10 | UBXDOC-963802114-12605 | Initial production |

# Contents

# 1 Functional description

## 1.1 Overview

MIA-M10C has an extremely small footprint to enable miniature product designs. Exceptional sensitivity and acquisition time for all L1 GNSS signals are attributed to its integrated M10 standard precision low power platform.

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.

MIA-M10C is cost and power optimized for designs where a SAW filter and an LNA are integrated in the external active antenna. It operates with an outstanding low power consumption of less than 15 mW in a 1 Hz cyclic tracking power save mode.

## 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[1] | Dynamics | ≤ 4 g |
| | Altitude | 80,000 m |
| | Velocity | 500 m/s |
| Velocity accuracy[2] | | 0.05 m/s |
| Dynamic heading accuracy[2] | | 0.3 deg |

**Table 1: MIA-M10C specifications**

| Parameter | | GPS+GAL | GPS+GAL +GLO | GPS+GAL +BDS B1I (default) | GPS+GAL +BDS B1C | GPS+GAL +BDS B1C +GLO |
|---|---|---|---|---|---|---|
| Max navigation update rate [3] | Default | 10 Hz | 6 Hz | 3 Hz | 8 Hz | 4 Hz |
| | High performance [4] | 20 Hz | 16 Hz | 12 Hz | 16 Hz | 10 Hz |
| Position accuracy (CEP) [5, 6] | | 1.5 m | 1.5 m | 1.5 m | 1.5 m | 1.5 m |

1 Assuming Airborne 4 g platform.
2 50% at 30 m/s for dynamic operation.
3 Minimum 98% fix rate under typical conditions.
4 Configuration required.
5 GPS is always in combination with SBAS and QZSS.
6 CEP, 50%, 24 hours static, –130 dBm, > 6 SVs for each GNSS system.

| Parameter | | GPS+GAL | GPS+GAL +GLO | GPS+GAL +BDS B1I (default) | GPS+GAL +BDS B1C | GPS+GAL +BDS B1C +GLO |
|---|---|---|---|---|---|---|
| Time To First Fix (TTFF) [5, 7, 8] | Cold start | 28 s | 24 s | 28 s | 29 s | 24 s |
| | Hot start | 1 s | 1 s | 1 s | 1 s | 1 s |
| | AssistNow Online [9] | 1 s | 1 s | 1 s | 1 s | 1 s |
| | AssistNow Offline [10] | 2 s | 2 s | 3 s | 2 s | 2 s |
| | AssistNow Autonomous [11] | 3 s | 4 s | 4 s | 4 s | 4 s |
| Sensitivity [12] | Tracking and navigation | –164 dBm | –164 dBm | –162 dBm | –162 dBm | –163 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 [7] | –159 dBm | –159 dBm | –159 dBm | –159 dBm | –159 dBm |

**Table 2: MIA-M10C typical performance in multi-constellation GNSS modes.**

| Parameter | | GPS | GLONASS | BDS B1I | GALILEO | BDS B1C |
|---|---|---|---|---|---|---|
| Max navigation update rate [3] | Default | 18 Hz | 18 Hz | 18 Hz | 18 Hz | 18 Hz |
| | High performance [4] | 25 Hz | 25 Hz | 25 Hz | 25 Hz | 25 Hz |
| Position accuracy (CEP) [5, 6] | | 1.5 m | 4 m | 2 m | 3 m | 2 m |
| Time To First Fix (TTFF) [5, 7, 8] | Cold start | 29 s | 27 s | 31 s | 41 s | 65 s |
| | Hot start | 1 s | 1 s | 1 s | 1 s | 1 s |
| | AssistNow Online [9] | 1 s | 2 s | 2 s | 7 s | N/A |
| Sensitivity [12] | Tracking and navigation | –163 dBm | –160 dBm | –158 dBm | –159 dBm | –159 dBm |
| | Reacquisition | –160 dBm | –158 dBm | –157 dBm | –155 dBm | –156 dBm |
| | Cold Start | –148 dBm | –147 dBm | –144 dBm | –137 dBm | –133 dBm |
| | Hot start [7] | –159 dBm | –159 dBm | –158 dBm | –155 dBm | –157 dBm |

**Table 3: MIA-M10C typical performance in single-GNSS modes**

## 1.3 Supported GNSS constellations

MIA-M10C 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 MIA-M10C is concurrent reception of GPS, Galileo, and BeiDou B1I with QZSS and SBAS enabled.

The following GNSS and their signals are supported:

| System | Signals |
|---|---|
| GPS / QZSS | L1C/A (1575.42 MHz) |
| Galileo | E1-B/C (1575.42 MHz) |

7 Commanded starts.

8 All satellites at –130 dBm. Measured at room temperature.

9 Dependent on the speed and latency of the aiding data connection, commanded starts.

10 Using seven days old AssistNow Offline data. External memory may be required.

11 Using two days old orbital predicted data. External memory may be required.

12 Demonstrated with a good external LNA. Measured at room temperature.

| System | Signals |
|---|---|
| GLONASS | L1OF (1602 MHz + k*562.5 kHz, k = -7,..., 5, 6) |
| BeiDou[13] | B1I (1561.098 MHz), B1C (1575.42 MHz) |

**Table 4: Supported GNSS and signals on MIA-M10C**

The following GNSS assistance services are supported:

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

MIA-M10C 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[14] | 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, hardware standby mode, and software standby mode, all with optional RTC |
| Power save modes[15] | On/off, cyclic tracking |
| Super-S | Improved dynamic position accuracy with small antennas |
| 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 |

13 BeiDou B1I cannot be enabled simultaneously with BeiDou B1C or GLONASS L1OF.

14 External components required, some pins need to be reconfigured.

15 The power save modes are not available if BeiDou B1C is enabled.

| Feature | Description |
|---|---|
| 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 are executed |

**Table 9: Security features**

# 2 System description

## 2.1 Block diagram

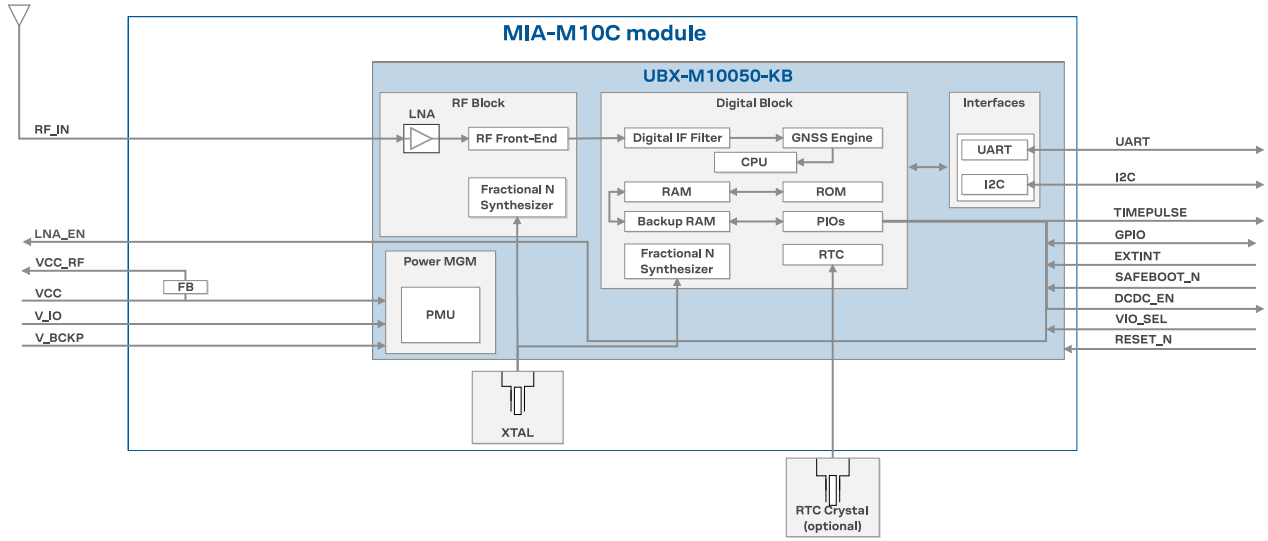


**Figure 1: MIA-M10C block diagram**

# 3 Pin definition

## 3.1 Pin assignment

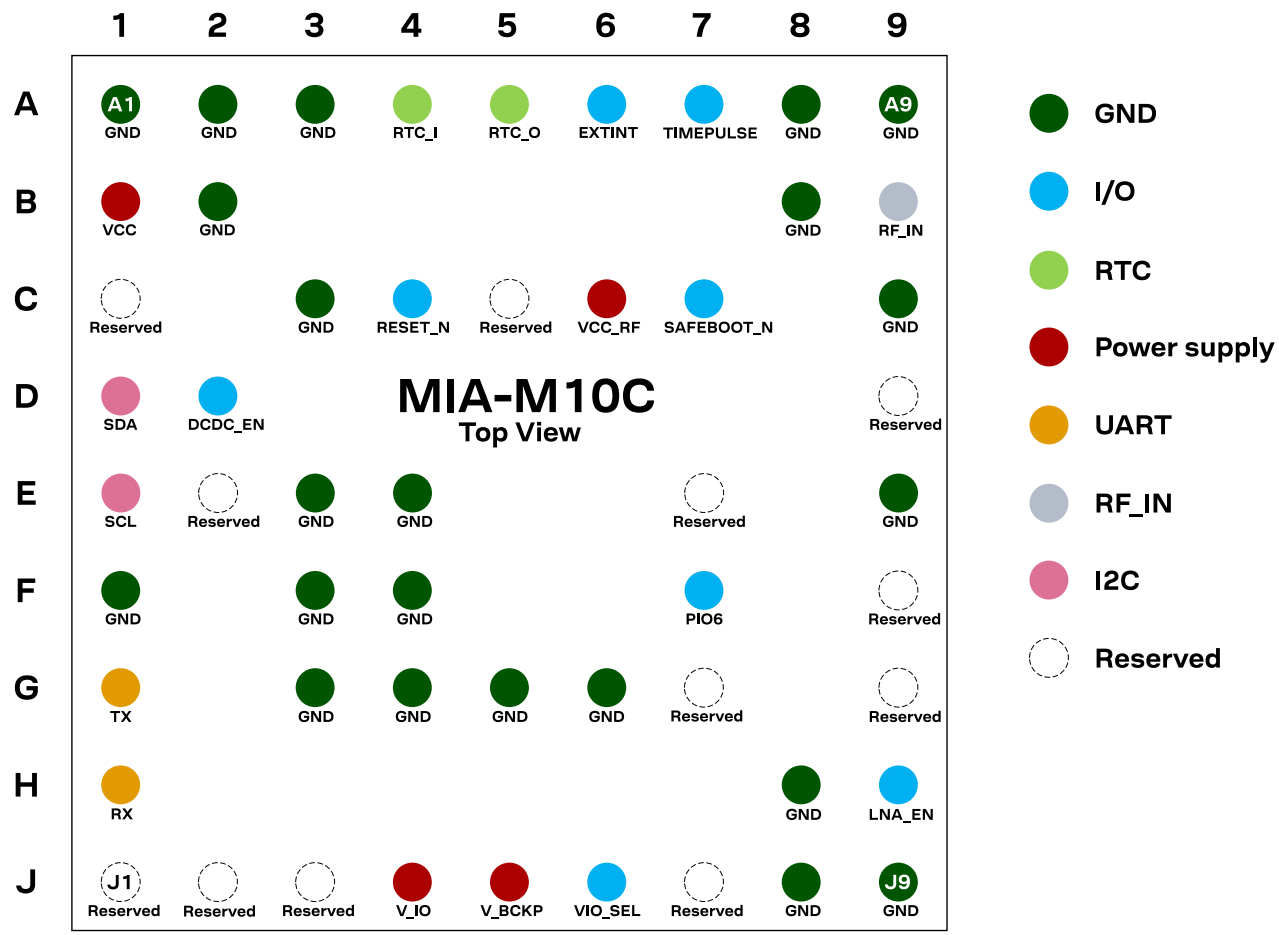


**Figure 2: MIA-M10C pin assignment**

| Pin no. | Name | PIO no. | I/O | Description |
|---|---|---|---|---|
| A1 | GND | - | - | Connect to GND |
| A2 | GND | - | - | Connect to GND |
| A3 | GND | - | - | Connect to GND |
| A4 | RTC_I | - | I | RTC input. Leave open if not used. |
| A5 | RTC_O | - | O | RTC output. Connect to GND if not used. |
| A6 | EXTINT | 5 | I | External interrupt |
| A7 | TIMEPULSE | 4 | O | Time pulse signal (shared with SAFEBOOT_N pin)[16] |
| A8 | GND | - | - | Connect to GND |
| A9 | GND | - | - | Connect to GND |
| B1 | VCC | - | I | Main power supply input |
| B2 | GND | - | - | Connect to GND |
| B8 | GND | - | - | Connect to GND |

| Pin no. | Name | PIO no. | I/O | Description |
|---|---|---|---|---|
| B9 | RF_IN | - | I | RF signal input |
| C1 | Reserved | - | - | Leave open |
| C3 | GND | - | - | Connect to GND |
| C4 | RESET_N | - | I | System reset (active low). Has to be low for at least 1 ms to trigger a reset. |
| C5 | Reserved | - | - | Leave open |
| C6 | VCC_RF | - | O | Filtered power supply for RF active components like external active antenna or LNA, both optional |
| C7 | SAFEBOOT_N | - | I | Safeboot mode (active low). Leave open if not used.[16] |
| C9 | GND | - | - | Connect to GND |
| D1 | SDA | 2 | I/O | I2C data. Leave open if not used. |
| D2 | DCDC_EN | - | O | Enable/disable external DC/DC converter. Leave open if not used. |
| D9 | Reserved | - | - | Leave open |
| E1 | SCL | 3 | I | I2C clock. Leave open if not used. |
| E2 | Reserved | - | - | Leave open |
| E3 | GND | - | - | Connect to GND |
| E4 | GND | - | - | Connect to GND |
| E7 | Reserved | - | - | Leave open |
| E9 | GND | - | - | Connect to GND |
| F1 | GND | - | - | Connect to GND |
| F3 | GND | - | - | Connect to GND |
| F4 | GND | - | - | Connect to GND |
| F7 | PIO6 | 6 | I/O | Digital I/O |
| F9 | Reserved | - | - | Connect to GND[17] |
| G1 | TX | 1 | O | UART TX. Leave open if not used. |
| G3 | GND | - | - | Connect to GND |
| G4 | GND | - | - | Connect to GND |
| G5 | GND | - | - | Connect to GND |
| G6 | GND | - | - | Connect to GND |
| G7 | Reserved | - | - | Leave open[18] |
| G9 | Reserved | - | - | Leave open |
| H1 | RX | 0 | I | UART RX. Leave open if not used. |
| H8 | GND | - | - | Connect to GND |
| H9 | LNA_EN | - | O | On/Off external LNA or active antenna |
| J1 | Reserved | - | - | Leave open |
| J2 | Reserved | - | - | Leave open |
| J3 | Reserved | - | - | Leave open |
| J4 | V_IO | - | I | IO voltage supply |
| J5 | V_BCKP | - | I | Backup voltage supply. Leave open if no external backup supply. |

16 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.

17 For future compatibility with the MIA dual-band version, connect this pin to ground by placing a 0 Ω resistor to GND.

18 For compatibility with the TCXO-based MIA variant, add a placeholder for a 0 Ω resistor from this pin to GND.

| Pin no. | Name | PIO no. | I/O | Description |
|---|---|---|---|---|
| J6 | 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. |
| J7 | Reserved | - | - | Leave open |
| J8 | GND | - | - | Connect to GND |
| J9 | GND | - | - | Connect to GND |

**Table 10: MIA-M10C pin assignment**

## 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 | H1 | RXD | Input pull-up | Input pull-up | Input pull-up |
| 1 | G1 | TXD | Output | Input pull-up | Output |
| 2 | D1 | SDA | Input pull-up | Input pull-up | Input pull-up |
| 3 | E1 | SCL | Input pull-up | Input pull-up | Input pull-up |
| $4^{16}$ | C7 | SAFEBOOT_N | Output | Input pull-up | Output (low) |
| | A7 | TIMEPULSE | Output | Input pull-up | Output (low) |
| 5 | A6 | EXTINT | Input pull-up | Input pull-up | Input pull-up |
| 6 | F7 | Digital input | Input pull-up | Input pull-up | Input pull-up |
| 7 | H9 | LNA_EN | Output (high) | Input pull-down | Input pull-up |
| - | C4 | RESET_N | Input pull-up | Input pull-up | Input pull-up |

**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

## 4.1 Absolute maximum ratings

CAUTION. Risk of device damage. Exceeding the absolute maximum ratings may affect the lifetime and reliability of the device or permanently damage it. Do not exceed the absolute maximum ratings.

This product is not protected against overvoltage or reversed voltages. Use appropriate protection to avoid device damage from voltage spikes exceeding the specified boundaries.

| Symbol | Parameter | Min | Max | Unit |
|---|---|---|---|---|
| VCC | Main supply voltage | -0.3 | 1.98 | V |
| | Voltage ramp on VCC [19] | 25 | 35000 | µs/V |
| V_IO | IO supply voltage | -0.3 | 3.6 | V |
| | Voltage ramp on V_IO [19] | 25 | 35000 | µs/V |
| V_BCKP | Backup supply voltage | -0.3 | 3.6 | V |
| RTC_I | Voltage on RTC_I | -0.3 | 1.155 | V |
| V_PIO | Input voltage on RESET_N and digital pins. VIO_SEL = GND. | -0.3 | V_IO + 0.3 (max 1.98) | V |
| | Input voltage on RESET_N and digital pins. VIO_SEL = open. | -0.3 | V_IO + 0.3 (max 3.6) | V |
| I_PIO | Max source / sink current, digital pins [20] | -10 | 10 | mA |
| ICC_RF | Max source current, VCC_RF | | 200 | mA |
| $P_{rfin}$ | RF input power on RF_IN [21] | | +15 | dBm |
| $T_{amb}$ | Ambient temperature | -40 | +85 | °C |
| $T_s$ | Storage temperature | -40 | +85 | °C |

**Table 12: Absolute maximum ratings**

## 4.2 Operating conditions

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

The V_IO voltage range is selected with the VIO_SEL pin.

| Symbol | Parameter | Min | Typical | Max | Unit |
|---|---|---|---|---|---|
| VCC | Main supply voltage [22] | 1.35 | 1.8 | 1.98 | V |
| V_IO | IO supply voltage, VIO_SEL = GND | 1.68 | 1.8 | 1.98 | V |
| | IO supply voltage, VIO_SEL = open | 2.7 | 3.3 | 3.6 | V |
| V_BCKP | Supply voltage, backup domain | 1.65 | | 3.6 | V |
| $V\_IO_{SWITCH}$ | V_IO voltage threshold to switch an internal supply for the backup domain from V_IO to V_BCKP | | 1.45 | | V |
| VCC_RF | VCC_RF output voltage | | VCC - 0.1 | | V |

19 Exceeding the voltage ramp speed may permanently damage the device.

20 The SAFEBOOT_N pin has an internal 1 kΩ series resistor.

21 Test conditions: source impedance = 50 Ω, continuous wave.

22 Requires a stable and accurate supply voltage, 30 mVpp maximum voltage ripple up to 3 MHz.

| Symbol | Parameter | Min | Typical | Max | Unit |
|---|---|---|---|---|---|
| ICC_RF | VCC_RF output current | | | 50 | mA |
| $Z_{in}$ [23] | Input impedance at RF_IN | | 50 | | Ω |
| $NF_{tot}$ | Receiver chain noise figure | | 3.5 | | dB |
| Ext_gain [24] | External gain at RF_IN, normal gain mode (default) | | | 40 | dB |
| | External gain at RF_IN, low gain mode | 14 | | 50 | dB |
| | External gain at RF_IN, bypass mode | 23 | | 60 | dB |
| $T_{opr}$ | Operating temperature | -40 | | +85 | °C |

**Table 13: General operating conditions**

| Symbol | Parameter | Min | Typical | Max | Unit |
|---|---|---|---|---|---|
| $I_{leak}$ | Leakage current input pins [25] | | 25 | | nA |
| $V_{in}$ | Input pin voltage range | 0 | | V_IO | V |
| $V_{il}$ | Low-level input voltage | | | 0.63 | V |
| $V_{ih}$ | High-level input voltage | 0.68 x V_IO | | | V |
| $V_{ol}$ | Low-level output voltage, Iout = -2 mA [26] | | | 0.4 | V |
| $V_{oh}$ | High-level output voltage, Iout = 2 mA [26] | V_IO - 0.4 | | | V |
| $R_{pu, IO}$ | Pull-up resistance, Digital IO [27]. VIO_SEL = GND | 6 | 17 | 72 | kΩ |
| $R_{pu, IO}$ | Pull-up resistance, Digital IO [27] . VIO_SEL = open | 8 | 18 | 40 | kΩ |
| $R_{pd, IO}$ | Pull-down resistance, Digital IO | 21 | 80 | 180 | kΩ |
| $R_{pu, SAFEBOOT\_N}$ | Pull-up resistance, SAFEBOOT_N [28] | 6 | 17 | 72 | kΩ |
| $R_{pu, RESET\_N}$ | Pull-up resistance, RESET_N | 7 | 10 | 13 | kΩ |
| $V_{ol\_dcdcen}$ [29] | DCDC_EN low-level output voltage, Iout = -10 µA | | | 0.06 | V |
| $V_{oh\_dcdcen}$ [29] | DCDC_EN high-level output voltage, Iout = 10 µA | 1.45 | 1.55 | 1.65 | V |
| $R_p$ | Output resistance, DCDC_EN | 3 | 4.5 | 6 | kΩ |

**Table 14: Digital IO**

## 4.3 Oscillator parameters

Table 15 shows the electrical parameters for the RTC (optional).

| Parameter | Min | Typical | Max | Unit |
|---|---|---|---|---|
| RTC oscillator frequency | | 32768 | | Hz |
| RTC startup time | | 250 | 700 | ms |
| RTC crystal ESR | | | 100 | kΩ |
| RTC input capacitance at RTC_I, RTC_O (per pin to GND) | 7 | 10 | 14 | pF |
| RTC_I input voltage, external clock $V_{il\_RTC}$ | 0 | | 0.22 | V |

[23] The RF_IN input integrates a built-in DC block.

[24] The internal LNA gain is configurable.

[25] $V_{in}$ = V_IO, at room temperature.

[26] TIMEPULSE (PIO4) has 4 mA current drive/sink capability.

[27] TXD, RXD, TIMEPULSE, EXTINT, SCL, SDA, and LNA_EN.

[28] The SAFEBOOT_N pin has an additional 1 kΩ series resistor.

[29] Special voltage level and current drive capability. Can be used as an enable signal for an external DC/DC converter.

| Parameter | Min | Typical | Max | Unit |
|---|---|---|---|---|
| $V_{ih\_RTC}$ | 0.71 | | 1.1 | V |

**Table 15: RTC parameters**

## 4.4 Indicative power requirements

This section provides examples of typical current requirements. They are characterized on samples using a cold start command. The actual power requirements may vary depending on the firmware version used, the external circuitry, the number of satellites tracked, the signal strength, the type and time of start, duration, internal LNA gain mode, and the test conditions.

All values in Table 16, and Table 17 have been measured at 25 °C ambient temperature with the default configuration unless otherwise stated. SBAS and QZSS are active in all measurements.

Table 16 shows indicative current consumption for VCC and V_IO.

| Symbol (Parameter) | Conditions | GPS | GPS+GAL | GPS+GAL +GLO | GPS+GAL +BDS B1I (default) | GPS+GAL +BDS B1C | GPS+GAL +BDS B1C +GLO | Unit |
|---|---|---|---|---|---|---|---|---|
| $I_{VCC}$ [30, 31] (Current at VCC) | Acquisition [32] | 16.5 | 22 | 28 | 26 | 24.5 | 29 | mA |
| | Tracking (Continuous mode) | 13 | 15 | 18.5 | 19 | 18 | 21 | mA |
| | Tracking (Power save mode) [33] | 5 | 5.5 | 6.5 | 6.5 | - | - | mA |
| $I_{V\_IO}$ [30, 34] (Current at V_IO) | Acquisition and Tracking (Continuous mode) | 1.7 | 1.7 | 1.8 | 1.7 | 1.7 | 1.8 | mA |
| | Tracking (Power save mode) [33] | 1.5 | 1.5 | 1.5 | 1.5 | - | - | mA |

**Table 16: Typical currents for 1.8 V supply at VCC and V_IO**

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

Table 17 shows current consumption for the backup modes.

| Symbol | Parameter | Conditions | Typ. | Unit |
|---|---|---|---|---|
| $I_{V\_BCKP}$ [35] | Total current in hardware backup mode | V_BCKP = 3.3 V, V_IO = VCC = 0 V | 28 | µA |
| $I_{V\_IO}$ | V_IO current in software standby mode or in hardware standby mode | V_IO = 1.8 V | 37 | µA |
| | | V_IO = 3.3 V | 46 | µA |
| $I_{VCC}$ | VCC current in software standby mode | VCC = 1.8 V | 3 | µA |

**Table 17: Backup currents**

☞ Extreme operating temperatures can significantly impact the specified values. If an application operates near the min or max temperature limits, ensure the specified values are not exceeded.

30 1 Hz navigation update rate.

31 Internal LNA set to normal gain. Simulated signal using power levels of -130 dBm.

32 Average current from start-up until the first fix.

33 Cyclic tracking operation. BeiDou B1C is not supported in this mode.

34 Same current with voltage at V_IO = 1.8 V and 3.3 V.

35 $I_{V\_BCKP}$ current in normal operation (V_BCKP = 3.3 V, V_IO = VCC = 1.8 V) is ~3 µA.

# 5 Communication interfaces

The receiver supports communication over the 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_IO 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 |
|---|---|---|---|---|
| $R_u$ | Baud rate | 9600 | 921600 | bit/s |
| $\Delta_{Tx}$ | Tx baud rate accuracy | -1% | +1% | - |
| $\Delta_{Rx}$ | 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 the I2C Fast-mode. Backwards compatibility with the Standard-mode I2C bus operation is not supported. The interface can be operated only in the peripheral mode with a maximum clock frequency of 320 kHz[36].

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.

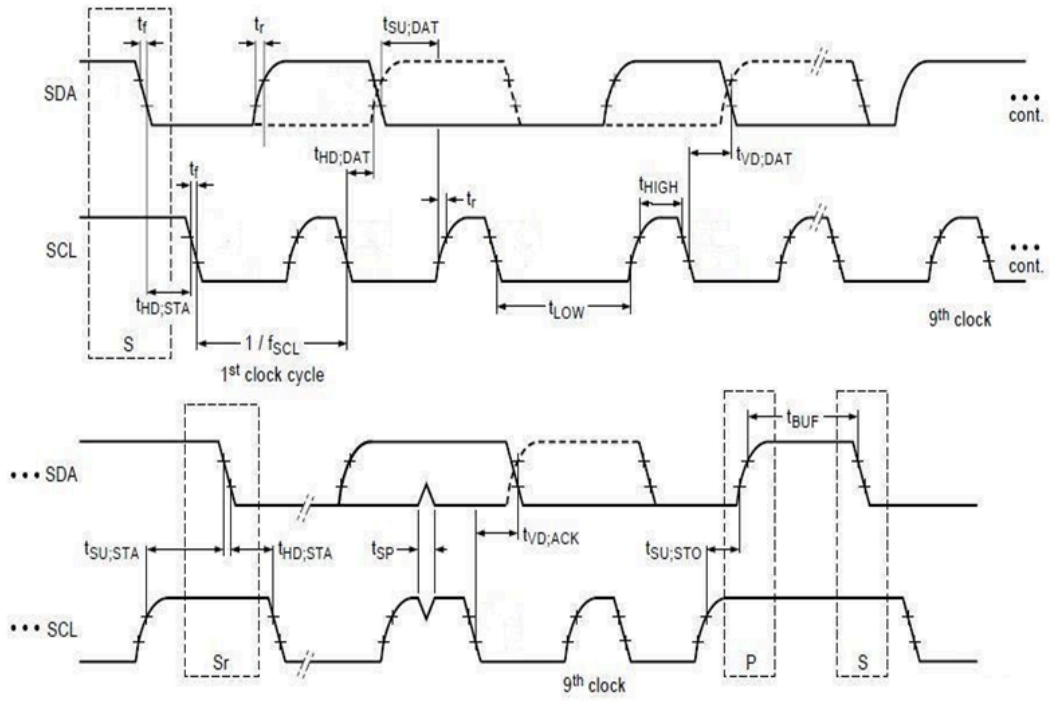


**Figure 3: I2C peripheral specification**

36 External pull-up resistors may be needed to achieve 320 kbit/s communication speed, as the internal pull-up resistance can be very large.

| | | I2C Fast-mode | | |
|---|---|---|---|---|
| **Symbol** | **Parameter** | **Min** | **Max** | **Unit** |
| $f_{SCL}$ | SCL clock frequency | 0 | 320 | kHz |
| $t_{HD;STA}$ | Hold time (repeated) START condition | 0.6 | - | µs |
| $t_{LOW}$ | Low period of the SCL clock | 1.3 | - | µs |
| $t_{HIGH}$ | High period of the SCL clock | 0.6 | - | µs |
| $t_{SU;STA}$ | Setup time for a repeated START condition | 0.6 | - | µs |
| $t_{HD;DAT}$ | Data hold time | 0 [37] | - [38] | µs |
| $t_{SU;DAT}$ | Data setup time | 100 | | ns |
| $t_r$ | Rise time of both SDA and SCL signals | - | 300 (for C = 400pF) | ns |
| $t_f$ | Fall time of both SDA and SCL signals | - | 300 (for C = 400pF) | ns |
| $t_{SU;STO}$ | Setup time for STOP condition | 0.6 | - | µs |
| $t_{BUF}$ | Bus-free time between a STOP and START condition | 1.3 | - | µs |
| $t_{VD;DAT}$ | Data valid time | - | 0.9 [38] | µs |
| $t_{VD;ACK}$ | Data valid acknowledge time | - | 0.9 [38] | µs |
| $V_{nL}$ | Noise margin at the low level | 0.1 V_IO | - | V |
| $V_{nH}$ | Noise margin at the high level | 0.2 V_IO | - | V |

**Table 19: MIA-M10C I2C peripheral timing and specifications**

## 5.3 Default interface settings

| Interface | Settings |
|---|---|
| UART | • 38400 baud[39], 8 bits, no parity bit, 1 stop bit.<br>• Input messages: NMEA and UBX.<br>• Output messages: NMEA GGA, GLL, GSA, GSV, RMC, VTG and TXT. |
| I2C | • 7-bit I2C address (0x42).<br>• Input messages: NMEA and UBX.<br>• Output messages: NMEA GGA, GLL, GSA, GSV, RMC, VTG and TXT. |

**Table 20: Default interface settings**

37 External device must provide a hold time of at least one transition time (max 300 ns) for the SDA signal (with respect to the min Vih of the SCL signal) to bridge the undefined region of the falling edge of SCL.

38 The maximum $t_{HD;DAT}$ must be less than the maximum $t_{VD;DAT}$ or $t_{VD;ACK}$ with a maximum of 0.9 µs by a transition time. This maximum must only be met if the device does not stretch the LOW period (tLOW) of the SCL signal. If the clock stretches the SCL, the data must be valid by the set-up time before it releases the clock.

39 9600 baud in the safe boot mode.

# 6 Mechanical specifications

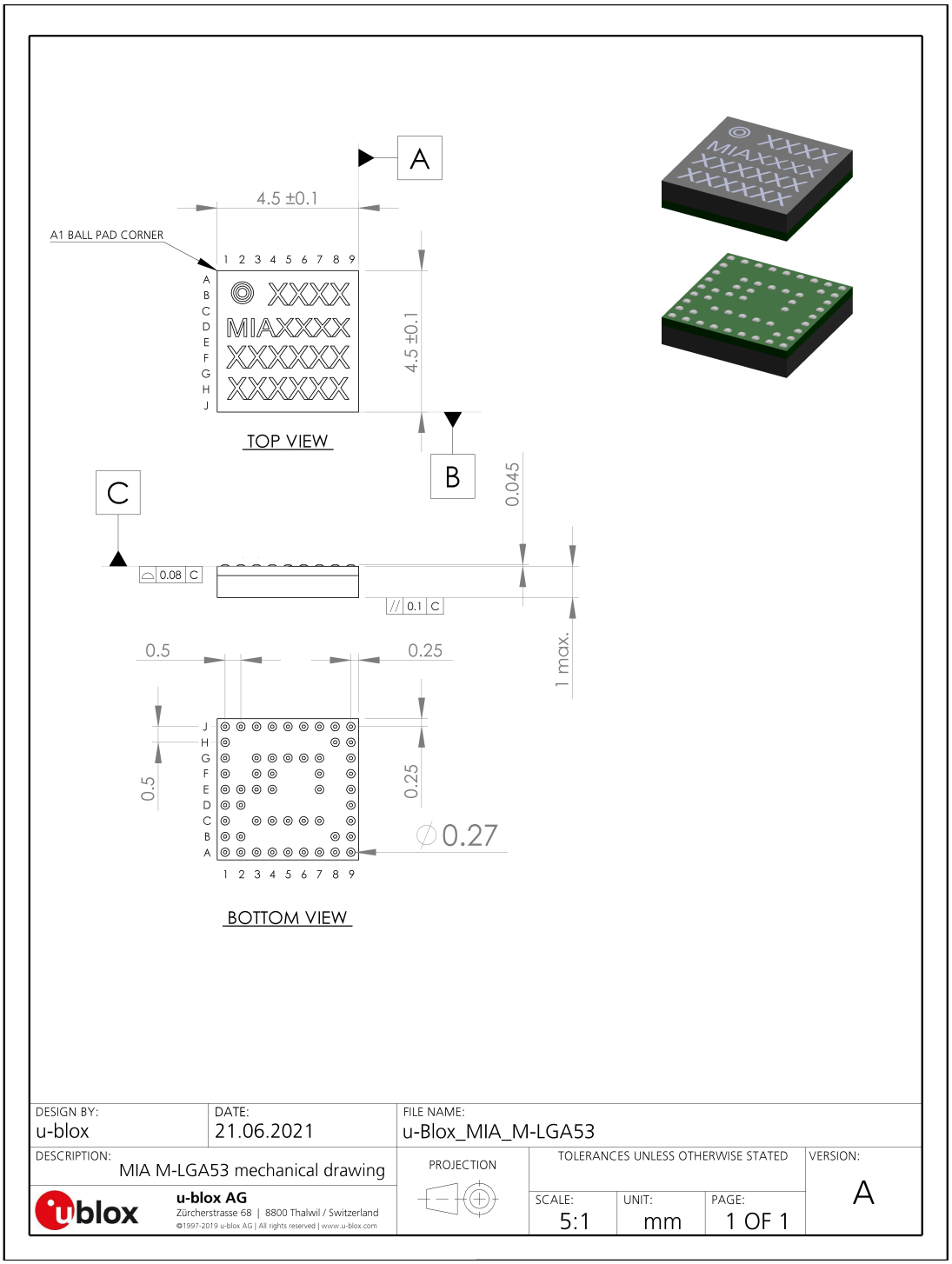


**Figure 4: MIA-M10C mechanical drawing**

# 7 Approvals

MIA-M10C complies with the essential requirements and other relevant provisions of the Radio Equipment Directive (RED) 2014/53/EU.

MIA-M10C 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.

# 8 Product handling

## 8.1 Moisture sensitivity level

The moisture sensitivity level (MSL) relates to the packaging and handling precautions required. MIA-M10C SiPs are rated at MSL level 3. 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 MIA-M10C package provides product information and revision information. For more information contact, u-blox sales.

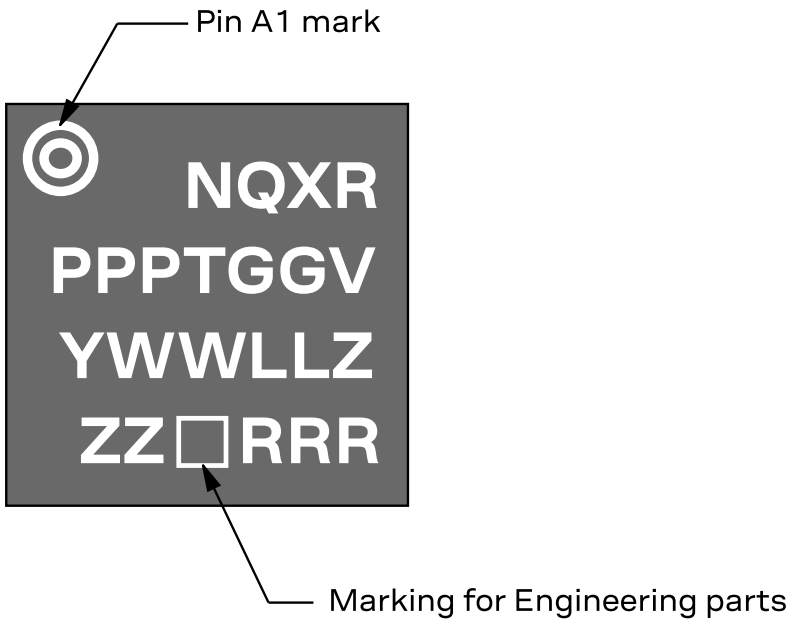


**Figure 5: MIA-M10C label**

The parts of the product code are explained in Table 21

| Code | Meaning | Example |
|---|---|---|
| PPP | Product family | MIA |
| TGG | Platform | M10 = u-blox M10 |
| V | Variant | C = Standard precision, ROM and XTAL |
| N | Option | 0 = 00, 1 = 01, ... |
| Q | Quality grade | A = Automotive, B = Professional |
| X | Product detail | Describes hardware and firmware versions, 0 = 00, 1 = 01, etc. |
| R | Other production code | - |

**Table 21: Part identification code**

The eight-digit Date Code and Lot Number includes the production date and lot number information.

| Date Code and Lot Number | Meaning |
|---|---|
| YWWLLZZZ | Y = production year, A = 2017, B = 2018,..., F = 2022, G =2023, etc.<br>WW = calendar week<br>LL = lot number<br>ZZZ = other production information |
| RRR | Other production code |

**Table 22: Production date and lot number information**

## 9.2 Explanation of product codes

Three product code formats are used in the product label. 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 23 describes the three different product code formats used in the MIA-M10C module.

| Format | Structure | Product code |
|---|---|---|
| Product name | PPP-TGGV | MIA-M10C |
| Ordering code | PPP-TGGV-NNQ | MIA-M10C-00B |
| Type number | PPP-TGGV-NNQ-XX | MIA-M10C-00B-01 |

**Table 23: Product code formats**

## 9.3 Ordering codes

| Ordering code | Product | Remark |
|---|---|---|
| MIA-M10C-00B | u-blox M10 GNSS receiver module, professional grade | |

**Table 24: 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] MIA-M10C Integration manual, UBX-23001616
[2] u-blox M10 SPG 5.10 Release notes, UBX-22001426
[3] u-blox M10 SPG 5.10 Interface description, UBX-21035062
[4] u-blox Package Information Guide, UBX-14001652
[5] MSL standard IPC/JEDEC J-STD-020, 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 | Comments |
|---|---|---|
| R01 | 15-Mar-2023 | Initial release |
| R02 | 16-May-2023 | Added 1 Hz navigation update rate footnote in section Indicative power requirements. |
| R03 | 19-Jan-2024 | Engineering sample<br>Added sections:<br>• Pin state<br>Updated sections:<br>• Performance<br>• Firmware features: removed Protection level (not supported)<br>• Operating conditions: added information on the input impedance and the DC block at RF_IN<br>• Indicative power requirements |
| R04 | 01-Feb-2024 | Initial production<br>Added sections:<br>• Approvals<br>Updated sections:<br>• Performance |

# Contact

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For further support and contact information, visit us at www.u-blox.com/support.