POSITIONING

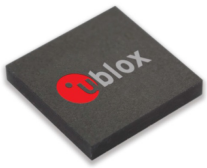
EVA-M8M

u-blox M8 concurrent GNSS modules

Data Sheet

Highlights:

- Industry's smallest standalone GPS/QZSS, GLONASS, BeiDou modules
- Minimal system cost
- Eases design and manufacturing
- No host integration or external components needed
- Backward compatible with EVA-7M



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Objective Specification	Document contains target values. Revised and supplementary data will be published later.
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This document applies to the following products:

Product name	Type number	ROM/FLASH version	PCN reference
EVA-M8M	EVA-M8M-0-00	ROM 2.01 / Flash FW 2.01	N/A
EVA-M8M	EVA-M8M-1-00	ROM 2.01 / Flash FW 2.01	N/A

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Contents

1 Functional description

1.1 Overview

The EVA-M8M GNSS modules feature the exceptional performance of the u-blox M8 concurrent positioning engine (receiving GPS, GLONASS, BeiDou, QZSS and SBAS signals). The EVA-M8M series modules deliver high sensitivity and minimal acquisition times in the ultra compact EVA form factor.

The EVA-M8M series is an ideal solution for cost and space-sensitive applications. It is easy to design in, only requiring an external GNSS antenna in most applications. The layout of the EVA-M8M series is especially designed to ease the customer's design and limit near field interferences, since RF and digital domains are kept separated.

The EVA-M8M series uses a crystal oscillator for lower system costs. Like other u-blox GNSS modules, the EVA-M8M series modules use components selected for functioning reliably in the field over the full operating temperature range.

With a dual-frequency RF front-end, the u-blox M8 concurrent GNSS engine is able to intelligently use the highest number of visible satellites from two GNSS (GPS, GLONASS and BeiDou) systems for reliable positioning. The EVA-M8M series comes in two variants. The EVA-M8M-0 defaults to reception of GPS/QZSS/GLONASS signals and fits global applications, whereas EVA-M8M-1 defaults to GPS/QZSS/BeiDou satellites, making it the ideal module for China. The right satellite constellations can be selected without touching software, and therefore reducing the design and testing effort.

The EVA-M8M series can be easily integrated in manufacturing, thanks to the QFN-like package. The modules are available in 500 pcs/reel, ideal for small production batches. The modules combine a high level of integration capability with flexible connectivity options in a miniature package. This makes the EVA-M8M modules perfectly suited for size- and cost-sensitive industrial and wearable devices. The DDC (I2C compliant) interface provides connectivity and enables synergies with u-blox cellular modules.

The EVA-M8M modules are manufactured in ISO/TS 16949 certified sites and qualified as stipulated in the JESD47 standard.

1.2 Highlights

- Industry's smallest standalone GPS/QZSS, GLONASS, BeiDou modules
- Minimal system cost
- Simple integration with u-blox cellular modules
- Eases design and manufacturing
- No host integration or external components needed
- Backward compatible with EVA-7M

1.3 Product features

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

R = Galileo ready
O = Optional, or requires external components
C = Crystal

1.4 GNSS Performance

Parameter	Specification			
Receiver type	72-channel u-blox M8 engine GPS L1C/A SBAS L1C/A QZSS L1C/A GLONASS L1OF BeiDou B1 Galileo-ready E1B/C[1]			
	GNSS	**GPS & GLONASS**	**GPS & BeiDou**	**GPS**
Time-To-First-Fix[2]	Cold start	27 s	28 s	30 s
	Hot start	1 s	1 s	1 s
	Aided starts[3]	4 s	6 s[4]	3 s
Sensitivity[5]	Tracking & Navigation	–164 dBm	–162 dBm	–163 dBm
	Reacquisition	–159 dBm	–159 dBm	–159 dBm
	Cold start	–147 dBm	–147 dBm	–147 dBm
	Hot start	–156 dBm	–156 dBm	–156 dBm
	GNSS	**GPS & GLONASS**	**GPS & BeiDou**	**GPS**
Max navigation update rate	ROM Flash	10 Hz 5 Hz	10 Hz 5 Hz	18 Hz 10 Hz
Velocity accuracy[6]		0.05 m/s		
Heading accuracy[6]		0.3 degrees		
Horizontal position accuracy[7]	Autonomous SBAS	2.5 m 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)		
Operational limits[8]	Dynamics	≤ 4 g		
	Altitude	50,000 m		
	Velocity	500 m/s		

Table 1: EVA-M8M performance in different GNSS modes

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

1.5 Block diagram

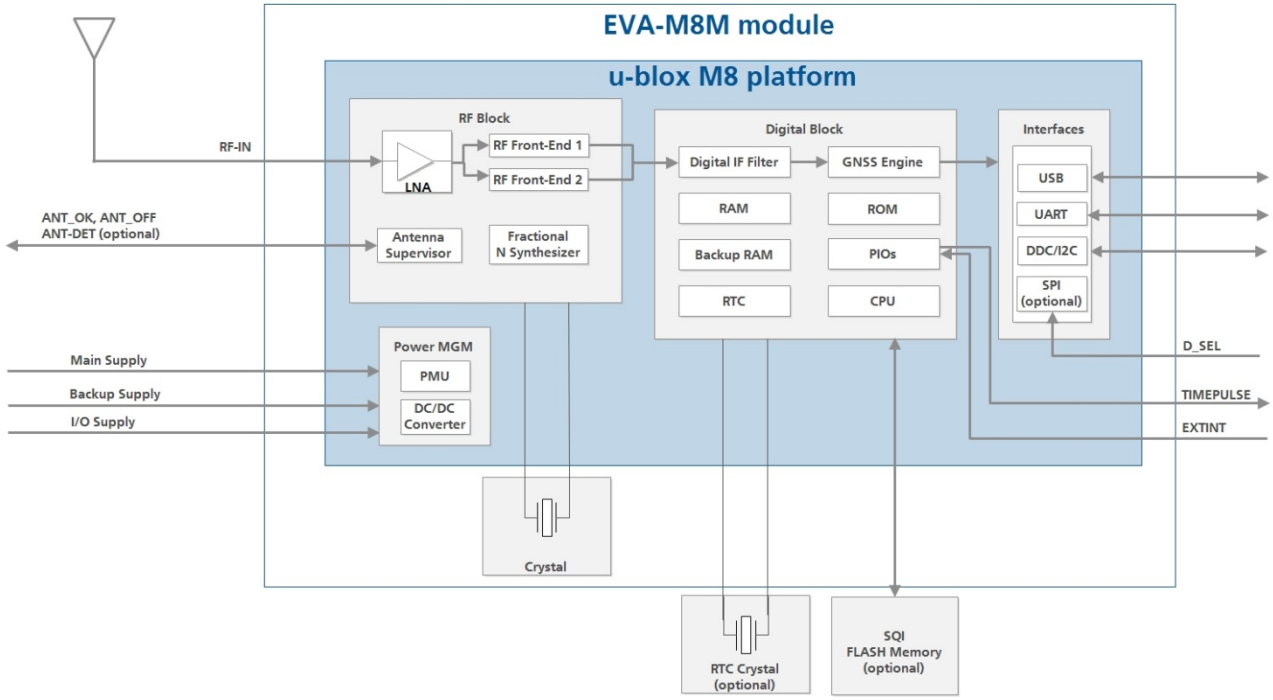


Figure 1: EVA-M8M block diagram

1.6 GNSS

The EVA-M8M modules are concurrent GNSS receivers and can receive and track multiple GNSS systems (e.g. GPS, GLONASS, BeiDou and QZSS signals). Because of the dual-frequency RF front-end architecture, two of the three signals (GPS L1C/A, GLONASS L1OF and BeiDou B1) can be received and processed concurrently. The EVA-M8M series has two variants: EVA-M8M-0 (default: concurrent GPS/QZSS/SBAS and GLONASS) and EVA-M8M-1 (default: concurrent GPS/QZSS/SBAS and BeiDou). If power consumption is a key factor, then the EVA-M8M should be configured for single GNSS operation using GPS or GLONASS or BeiDou and disabling QZSS and SBAS.

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

When the EVA-M8M-1 variant is attached with an external SQI flash without running flash firmware, the default concurrent reception of GPS/QZSS/SBAS and BeiDou remains unchanged. If the flash is also used for execution of firmware update, the default reception will be reset to GPS/QZSS/SBAS and GLONASS. See the *EVA-M8M Hardware Integration Manual* [1] for more information on how to preset default concurrent reception of GPS/QZSS/SBAS and BeiDou.

1.6.1 GPS

The EVA-M8M positioning modules are designed to receive and track the L1C/A signals provided at 1575.42 MHz by the Global Positioning System. The EVA-M8M modules can receive and process GPS concurrently with GLONASS or BeiDou.

1.6.2 GLONASS

The EVA-M8M modules can receive and process GLONASS concurrently with GPS or BeiDou. The Russian GLONASS satellite system is an alternative system to the US-based Global Positioning System (GPS). The u-blox

EVA-M8M series is designed to receive and track the L1OF signals GLONASS provided at 1602 MHz + k*562.5 kHz, where k is the satellite's frequency channel number (k = –7,..., 5, 6). The ability to receive and track GLONASS L1OF satellite signals allows design of GLONASS receivers where required by regulations.

To take advantage of GPS and GLONASS, dedicated hardware preparation must be made during the design-in phase. See the *EVA-M8M Hardware Integration Manual* [1] for u-blox design recommendations.

1.6.3 BeiDou

The EVA-M8M modules can receive and process BeiDou concurrently with GPS or GLONASS. u-blox EVA-M8M positioning modules are designed to receive and track the B1 signals provided at 1561.098 MHz by the BeiDou Navigation Satellite System. The ability to receive and track BeiDou B1 satellite signals in conjunction with GPS results in higher coverage, improved reliability and better accuracy. Global coverage is scheduled for 2020.

1.6.4 QZSS

The Quasi-Zenith Satellite System (QZSS) is a regional navigation satellite system that transmits additional GPS L1C/A signals for the Pacific region covering Japan and Australia. The EVA-M8M modules are able to receive and track these signals concurrently with GPS signals, resulting in better availability especially under bad signal conditions, e.g. in urban canyons.

☞ The L1-SAIF signal provided by QZSS is not supported.

1.7 Assisted GNSS (A-GNSS)

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. The EVA-M8M modules support u-blox' AssistNow Online, AssistNow Offline A-GNSS services, supports AssistNow Autonomous, and are OMA SUPL compliant.

1.7.1 AssistNow™ Online

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

1.7.2 AssistNow™ Offline

With AssistNow Offline, users download u-blox' Differential Almanac Correction Data from the Internet at their convenience. The correction data can be stored in the memory of the application processor or external SQI flash memory (if available). Therefore, the service requires no connectivity at system start-up and enables a position fix within seconds, even when no network is available. AssistNow Offline offers augmentation for up to 35 days.

1.7.3 AssistNow™ Autonomous

AssistNow Autonomous provides aiding information without the need for a host or external network connection. It is an embedded feature available free-of-charge that accelerates GNSS positioning by capitalizing on the periodic nature of GPS satellite orbits: their position in the sky is basically repeated every 24 hours. GPS orbit predictions are directly calculated by the GNSS 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.

u-blox' AssistNow Autonomous benefits are:

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

The ROM-based EVA-M8M receivers can use AssistNow Autonomous to calculate GPS-only orbit predictions for up to 6 days (3 days by defaults). For best AssistNow Autonomous performance, it is recommended to utilize the SQI flash interface available in the EVA-M8M series for data storage.

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

1.8 Augmentation Systems

1.8.1 Satellite-Based Augmentation System (SBAS)

u-blox EVA-M8M positioning modules support SBAS. These systems supplement GPS data with additional regional or wide area GPS augmentation data. The system broadcasts the augmentation data via satellite and this information can be used by the EVA-M8M modules 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 the EVA-M8M modules: WAAS, EGNOS and MSAS.

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

1.8.2 Differential GPS (D-GPS)

u-blox EVA-M8M modules support Differential-GPS data according to RTCM 10402.3: "RECOMMENDED STANDARDS FOR DIFFERENTIAL GNSS". The use of Differential-GPS data improves GPS position accuracy. RTCM cannot be used together with SBAS. The RTCM implementation supports the following RTCM 2.3 messages:

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

Table 2: Supported RTCM 2.3 messages

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

1.9 Data logging

The EVA-M8M modules can be used in data logging applications with an external SQI flash. The data logging feature enables continuous storage of position, velocity and time information to the 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 M8 Receiver Description Including Protocol Specification* [2].

1.10 Odometer

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

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

1.11 EXTINT: External interrupt

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

For more information about how to implement and configure these features, see the *u-blox M8 Receiver Description including Protocol Specification* [2] and the *EVA-M8M Hardware Integration Manual* [1].

1.11.1 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 turned off and sent into Backup Mode using **EXTINT** when Power Save Mode is not active.

1.11.2 Aiding

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

For time aiding, the time can be supplied using hardware time synchronization where an accurate time pulse is connected 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, and providing the applied frequency value to the receiver using UBX messages.

1.12 TIMEPULSE

A configurable time pulse signal is available with u-blox EVA-M8M series modules.

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

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

1.13 Protocols and interfaces

Protocol	Type
NMEA	Input/output, ASCII, 0183, version 4.0 (Configurable to 2.3 or 4.1)
UBX	Input/output, binary, u-blox proprietary
RTCM	Input, messages 1, 2, 3, 9

Table 3: Available Protocols

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

1.14 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.

1.14.1 UART

The EVA-M8M modules make use of a UART interface, which can be used for communication to a host. It supports configurable baud rates. For supported transfer rates see the *u-blox M8 Receiver Description Including Protocol Specification* [2].

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

1.14.2 USB

A USB interface, which is compatible to USB version 2.0 FS (Full Speed, 12 Mbit/s), 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 **V_USB** pin supplies the USB interface.

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

1.14.3 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 Mbit/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** to ground (see section 1.14.6). In this case the DDC interface for data communication is no longer available.

1.14.4 Display Data Channel (DDC)

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

The DDC interface is I^2C Fast Mode compliant. For timing parameters consult the I^2C standard.

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

1.14.5 Serial Quad Interface (SQI)

An SQI is available in EVA-M8M series for connecting the modules with an optional external flash memory. The flash memory is required for firmware updates and for data logging. In addition, it can be used to store configurations and to save AssistNow Offline and AssistNow Autonomous data.

☞ For more information see the *EVA-M8M Hardware Integration Manual* [1].

1.14.6 Interface selection (D_SEL)

At startup the **D_SEL** pin determines which data interfaces are used for communication. If **D_SEL** is set to logical "1" or is not connected, UART and DDC become available. If **D_SEL** is set to logical "0", i.e. connected to **GND**, the EVA-M8M modules can communicate to a host via SPI.

Pin #	(D_SEL)="1" (left open)	(D_SEL)="0" (connected to GND)
16	UART TX	SPI MISO
15	UART RX	SPI MOSI
29	DDC SCL	SPI CLK
30	DDC SDA	SPI CS_N

Table 4: Data interface selection by D_SEL

1.15 Configurable Input Output pins

Configuration settings can be modified for several Input/Output pins with either UBX configuration messages or pin selection. This flexible configuration options allow the receivers to be optimally configured for specific applications requirements. The modified settings remain either permanent or effective until power-down or reset depending on the case. Customer can activate or remap the following pins on EVA-M8M series:

1. Selection of either DDC or UART TX/RX pins interface using **D_SEL** pin. See section *1.14.6*.
2. Selection of antenna supervision pins. See section *1.20*.
3. Selection of external interrupt pins. See section *1.11*.
4. Configuration of Timepulse. See section *1.12*.

☞ For more information see the *EVA-M8M Hardware Integration Manual* [1].

1.16 Safe Boot Mode

If Pin33 (**SAFEBOOT_N**) is set to logical "0" at startup, the EVA-M8M receivers enter Safe Boot Mode. In this mode the receiver does not calculate positioning data, but is in a defined state that allows such actions as programming the flash memory in production, or recovering a corrupted flash memory.

☞ For more information about Safe Boot Mode see the *EVA-M8M Hardware Integration Manual* [1].

1.17 System reset

The EVA-M8M series provides a **RESET_N** pin to reset the system and Real-Time Clock (RTC). The **RESET_N** pin should be only used in critical situations to recover the system.

1.18 Clock generation

1.18.1 Oscillator

The EVA-M8M modules use a 26 MHz crystal oscillator for lower system costs. Like other u-blox GNSS modules, the EVA-M8M modules use components selected for functioning reliably in the field over the full operating temperature range.

1.18.2 Real-Time Clock (RTC)

The use of the RTC Clock may be optionally used to maintain time in the event of power failure at **VCC_IO**. The RTC is required for hot start, warm start, AssistNow Autonomous, AssistNow Offline and some Power Save Mode operations.

The use of the RTC is optional. The time information can be generated in one of these ways:

- by connecting to an external RTC crystal (for lower battery current – default mode)
- by sharing from another RTC oscillator used within the application (for lowest system costs and smallest size)
- from deriving RTC time from the onboard 26 MHz crystal oscillator (for low system costs and small size)

If the main supply voltage fails and a battery is connected to **V_BCKP**, parts of the baseband section 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.

☞ For more information about crystal operation and configuration, see the *EVA-M8M Hardware Integration Manual* [1].

☞ If neither backup RAM nor RTC are used, the backup battery is not needed and **V_BCKP** should be connected to **VCC_IO**.

1.19 Power Management

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

1.19.1 DC/DC converter

EVA-M8M modules integrate a DC/DC converter, allowing reduced power consumption by up to 50%, especially when using a main supply voltage above 2.5 V.

☞ For more information, see the *EVA-M8M Hardware Integration Manual* [1].

1.19.2 Operating modes

The EVA-M8M modules have two operating modes:

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

1.19.2.1 Continuous Mode

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

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

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

1.19.2.2 Power Save Mode

For power sensitive applications, the EVA-M8M series provides 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 M8 Receiver Description Including Protocol Specification* [2].

☞ Power Save Mode is only available in GPS mode.

1.20 Antenna

The EVA-M8M modules are designed for use with passive[9] and active[10] antennas.

Parameter	Specification	
Antenna Type	Passive and active antenna	For Passive antenna, an external LNA is mandatory to achieve the performance specified in this document
Active Antenna Recommendations	Minimum gain Maximum gain Maximum noise figure	15 dB (to compensate signal loss in RF cable) 50 dB 2 dB

Table 5: Antenna recommendations and specifications for EVA-M8M modules

1.20.1 Active antenna control (ANT_OFF)

The **ANT_OFF** Pin can be used to turn on and off an external LNA or an active antenna. This reduces power consumption in Power Save Mode (Backup mode). This pin is available in EVA-M8M modules.

☞ **ANT_OFF** pin polarity can be changed. For more information about active antenna control, see the *EVA-M8M Hardware Integration Manual* [1].

1.20.2 Active Antenna supervisor and short circuit detection

An antenna supervisor is available with the EVA-M8M modules and requires external components. The antenna supervisor enables the receiver to detect short circuits at the active antenna using the **ANT_OFF** and **ANT_OK** pins (activated per default) and to shut down the voltage bias immediately. The antenna supervisor can be extended to also detect condition of open circuit by activating the **ANT_DET** pin and including external components for antenna open circuit detection. UBX and NMEA messages are provided to report the condition of the antenna supply. Open circuit detection can also be supported.

☞ For more information see the EVA-M8M Hardware Integration Manual [1].

[9] For integration EVA-M8M modules with Cellular products, see the *EVA-M8M Hardware Integration Manual* [1].
[10] For information on using active antennas with EVA-M8M modules, see the *EVA-M8M Hardware Integration Manual* [1].

2 Pin definition

2.1 Pin assignment

This section shows the pin assignments. Most PIOs are configurable and have shared functions. Use special care when designing with these pins since the overall function of the device can be affected.

The default configuration of the PIOs is listed in Table 6 below.

For more information see the EVA-M8M Hardware Integration Manual [1].

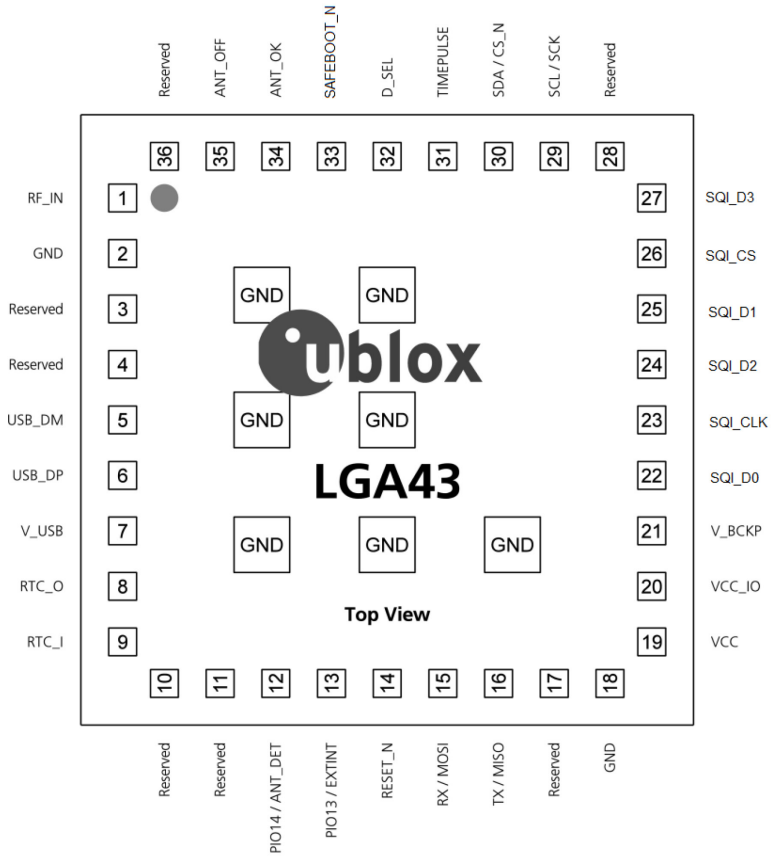


Figure 2: Pin assignment of EVA-M8M (LGA43)

For multiple function PIOs, select the specific signal by sending the specific configuration message or by e-fusing.

Pin #	Name	I/O	Description	Remark
35	ANT_OFF	O	Antenna control	Leave open if not used.
34	ANT_OK	I	Antenna status	Leave open if not used.
32	D_SEL	I	Interface selector	See section *1.14.6*.
2	GND	I	Ground	
18	GND	I	Ground	
37	GND	I	Ground	Inner ground pins
38	GND	I	Ground	Inner ground pins
39	GND	I	Ground	Inner ground pins
40	GND	I	Ground	Inner ground pins
41	GND	I	Ground	Inner ground pins
42	GND	I	Ground	Inner ground pins
43	GND	I	Ground	Inner ground pins
13	PIO13 / EXTINT	I	External interrupt	Leave open if not used.
12	PIO14 / ANT_DET	I	Antenna detection	Leave open if not used.
3	Reserved	I/O	Reserved	Do not connect. Must be left open!
4	Reserved	I/O	Reserved	Do not connect. Must be left open!
10	Reserved	I/O	Reserved	Do not connect. Must be left open!
11	Reserved	I/O	Reserved	Do not connect. Must be left open!
17	Reserved	I/O	Reserved	Do not connect. Must be left open!
22	SQI_D0	I/O	Data line 0 to external SQI flash memory or reserved configuration pin.	Leave open if not used.
23	SQI_CLK	I/O	Clock for external SQI flash memory or configuration pin.	Leave open if not used.
24	SQI_D2	I/O	Data line 2 to external SQI flash memory or reserved configuration pin.	Leave open if not used.
25	SQI_D1	I/O	Data line 1 to external SQI flash memory or reserved configuration pin.	Leave open if not used.
26	SQI_CS	I/O	Chip select for external SQI flash memory or configuration enable pin.	Leave open if not used.
27	SQI_D3	I/O	Data line 3 to external SQI flash memory or reserved configuration pin.	Leave open if not used.
28	Reserved	I/O	Reserved	Do not connect. Must be left open!
33	SAFEBOOT_N	I	Used for programming the SQI flash memory and testing purposes.	Leave open if not used.
36	Reserved	I/O	Reserved	Do not connect. Must be left open!
14	RESET_N	I	System reset	See section *1.16*.
1	RF_IN	I	RF Input	Add external LNA and SAW if no active antenna used.
8	RTC_O	O	RTC Output	Leave open if no RTC Crystal attached.
9	RTC_I	I	RTC Input	Connect to GND if no RTC Crystal attached.
15	RX / MOSI	I	Serial interface	See section *1.14.6*.
29	SCL / SCK	I	Serial interface	See section *1.14.6*.
30	SDA / CS_N	I/O	Serial interface	See section *1.14.6*.
31	TIMEPULSE	O	Time pulse output	Leave open if not used.
16	TX / MISO	O	Serial interface	See section *1.14.6*.
5	USB_DM	I/O	USB data	Leave open if not used.
6	USB_DP	I/O	USB data	Leave open if not used.
21	V_BCKP	I	Backup supply	
19	VCC	I	Main supply	
20	VCC_IO	I	I/O Supply	
7	V_USB	I	USB Interface power	Connect to GND if not used.

Table 6: EVA-M8M pinout

3 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 limiting values 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 regarding power management see the *EVA-M8M Hardware Integration Manual* [1].

3.1 Absolute maximum rating

Symbol	Parameter	Min	Max	Unit
VCC	Supply voltage	–0.5	3.6	V
VCC_IO	Supply voltage I/O ring	–0.5	3.6	V
V_USB	Supply voltage USB	–0.5	3.6	V
V_BCKP	Supply voltage baseband backup core	–0.5	3.6	V
Vi_{RTC}	Input voltage on RTC_I	–0.5	1.6	V
Vi_{DIG}	Input voltage on Configurable Inputs , RESET_N	–0.5	3.6	V
Prfin	RF Input power on RF_IN		+15	dBm
Ptot	Total power dissipation		500	mW
Ts	Storage temperature	–40	+105	°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.

3.2 Operating conditions

☞ The test conditions specified in Table 8 apply to all characteristics defined in this section.

Symbol	Parameter	Min	Typical	Max	Unit	Remarks
Tamb	Ambient temperature	-40	+25	+85	°C	
GND	Ground		0		V	
VCC	Core supply voltage		3.3		V	
V_BCKP	Backup battery supply voltage		3.3		V	
VCC_IO	Supply voltage I/O ring		3.3		V	
V_USB	Supply voltage USB		3.3		V	
NFtot	Receiver Chain Noise Figure		5.0		dB	

Table 8: Test 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.

3.2.1 DC electrical characteristic

☞ For Power Management Unit (PMU) block diagrams, see the *EVA-M8M Hardware Integration Manual* [1].

Symbol	Parameter	Min	Typical	Max	Unit
VCC_IO	Supply voltage for PIOs and input voltage for LDO_B and LDO_X	1.65	3.3	3.6	V
V_USB	Supply voltage USB	3.0	3.3	3.6	V
V_BCKP	Input voltage for LDO_B and LDO_X (backup mode)	1.4		3.6	V
VCC	Input voltage	1.65		3.6	V

Table 9: Power supply pins

Symbol	Parameter	Condition	Min	Typical	Max	Unit
Ileak	Leakage current input pins			< 1		nA
Vil	Low level input voltage		0		0.2*VCC_IO	V
Vih	High level input voltage		0.7*VCC_IO		VCC_IO+0.5	V
Vol	Low level output voltage for TX/MISO, RX/MOSI , SDA/CS_N, SCL/SCK, D_SEL, TIMEPULSE, PIO13/EXTINT, PIO14/ANT_DET, ANT_OK, ANT_OFF	Iol = 4 mA			0.4	V
Voh	High level output voltage for TX/MISO, RX/MOSI , SDA/CS_N, SCL/SCK, D_SEL, TIMEPULSE, PIO13/EXTINT, PIO14/ANT_DET, ANT_OK, ANT_OFF	Ioh = 4 mA	VCC_IO-0.4			V
Rpu	Pull-up resistor for SDA/CS_N, SCL/SCK, TIMEPULSE, PIO13/EXTINT, PIO14/ANT_DET, RESET_N			11		kΩ
Rpu	Pull-up resistor for TX/MISO, RX/MOSI, D_SEL, ANT_OK, ANT_OFF			115		kΩ

Table 10: Digital IO pins

3.3 Indicative power requirements

Table 11 lists examples of the total system supply current for a possible application.

The values in Table 11 are provided for customer information only as an example of typical current requirements. The 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	Conditions	Typ GPS & GLONASS	Typ GPS / QZSS /SBAS	Max	Units
Max. supply current [11]	Iccp				67	mA
Average supply current [12]	Icc Acquisition [13]	VCC_IO = VCC = 3 V	27	22		mA
	Icc Tracking (Continuous mode)	VCC_IO = VCC = 3 V	25	19		mA
	Icc Tracking (Power Save mode / 1 Hz)	VCC_IO = VCC = 3 V	n.a. [14]	5.5		mA
Backup battery current [15]	I_BCKP using the RTC crystal	HW Backup mode, VCC_IO = VCC = 0 V		15		µA
	I_BCKP using the 26 MHz XTO in "single crystal" operation	HW Backup mode, VCC_IO = VCC = 0 V		100		µA
SW Backup current	I_SWBCKP using the RTC crystal	SW Backup mode, VCC_IO = VCC = 3 V		20		µA
	I_SWBCKP using the 26 MHz XTO in "single crystal" operation	SW Backup mode, VCC_IO = VCC = 3 V		105		µA

Table 11: Currents to calculate the indicative power requirements

For more information about power requirements, see the *EVA-M8M Hardware Integration Manual* [1].

All values in Table 11 are measured at 25°C ambient temperature.

3.4 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 12: Symbol description

[11] Use this figure to dimension maximum current capability of power supply. Measurement of this parameter with 1 Hz bandwidth.
[12] Simulated constellation of 8 satellites is used. All signals are at -130 dBm. VCC= 3 V
[13] Average current from start-up until the first fix.
[14] Not applicable
[15] Use this figure to determine required battery capacity.

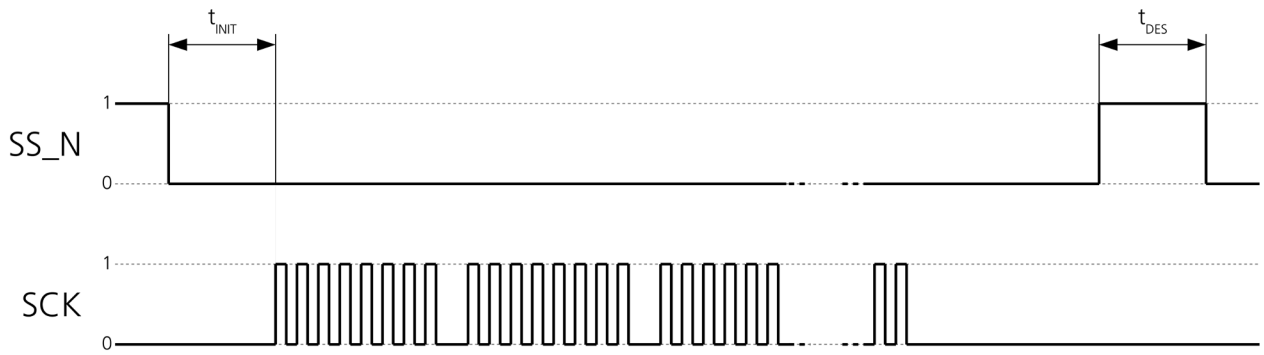


Figure 3: SPI timing diagram

3.4.1 Timing recommendations

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

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

Table 13: 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 Mechanical specification

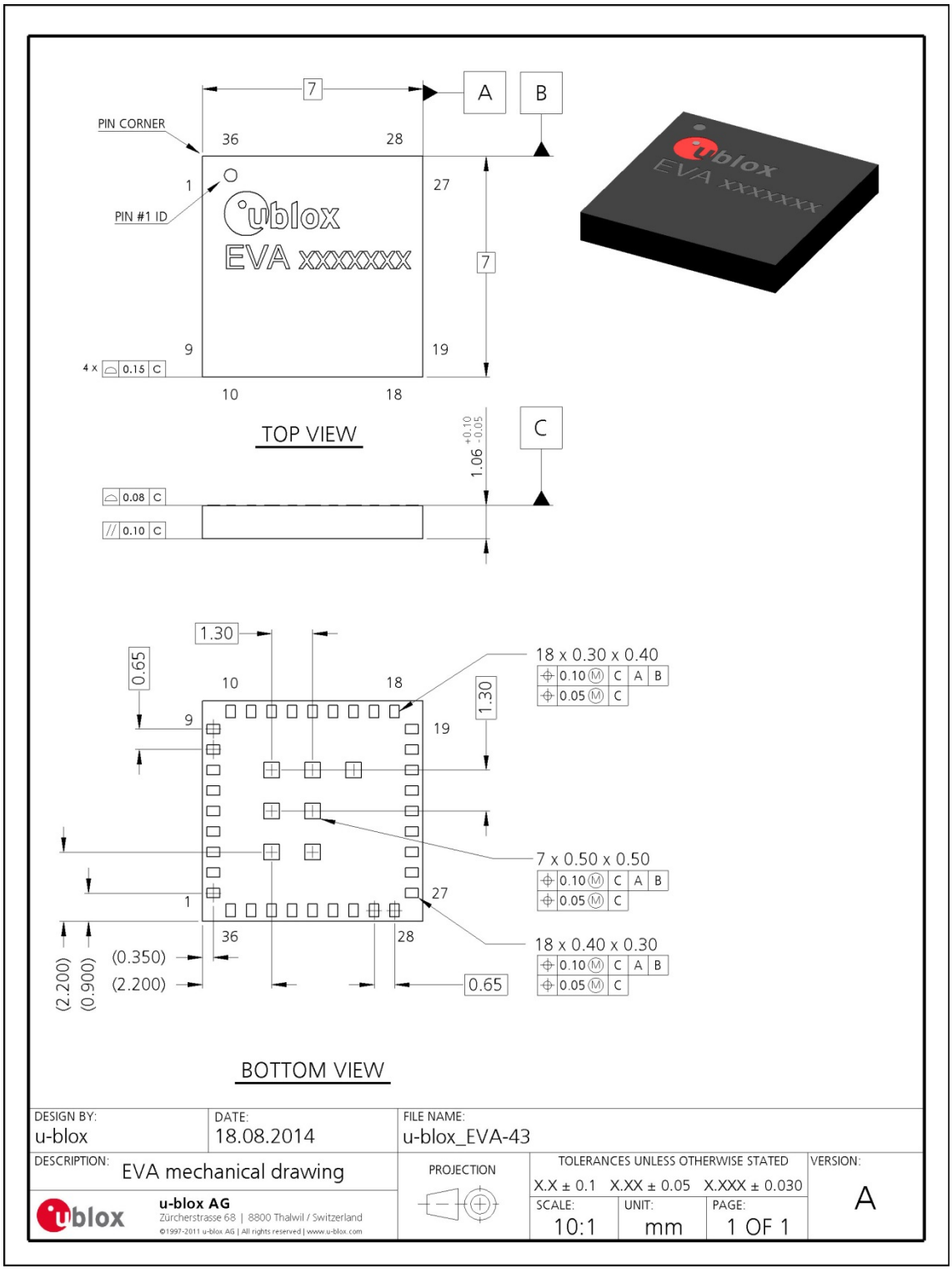


Figure 4: Mechanical drawing for EVA-M8M (LGA43)

5 Reliability tests and approvals

5.1 Reliability tests

Qualification requirements according JEDEC standards JESD47 "*Stress-Test-Driven Qualification of Integrated Circuits*".

5.2 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).

EVA-M8M modules are RoHS compliant and green (no halogens).

6 Product handling

6.1 Packaging

EVA-M8M series modules are delivered as hermetically sealed, reeled tapes in order to enable efficient production, production lot set-up and tear-down. For more information about packaging, see the *u-blox Package Information Guide* [3].

6.1.1 Reels

EVA-M8M series modules are deliverable in quantities of 500 pcs on a reel. The EVA-M8M modules are shipped on Reel Type D, as described in the *u-blox Package Information Guide* [3].

6.1.2 Tapes

Figure 5 shows the feed direction and the orientation of the EVA-M8M positioning modules on the tape. The positioning modules are placed such that the pin 1 is at the upper right for the LGA43. The dimensions of the tapes are specified in Figure 6.

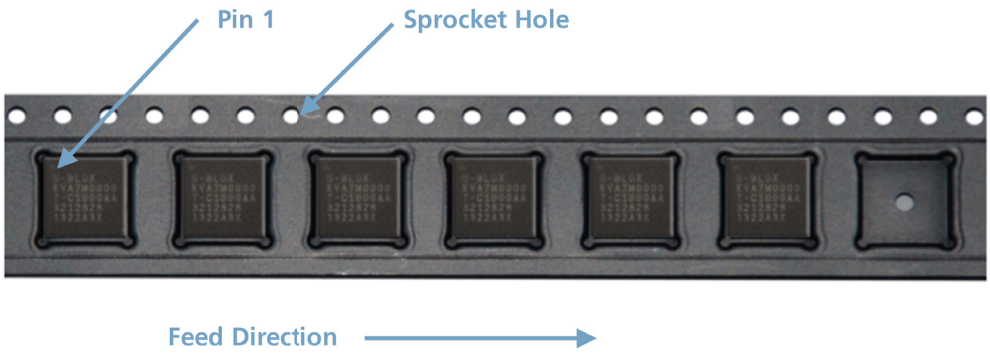


Figure 5: Orientation of EVA-M8M modules on the tape

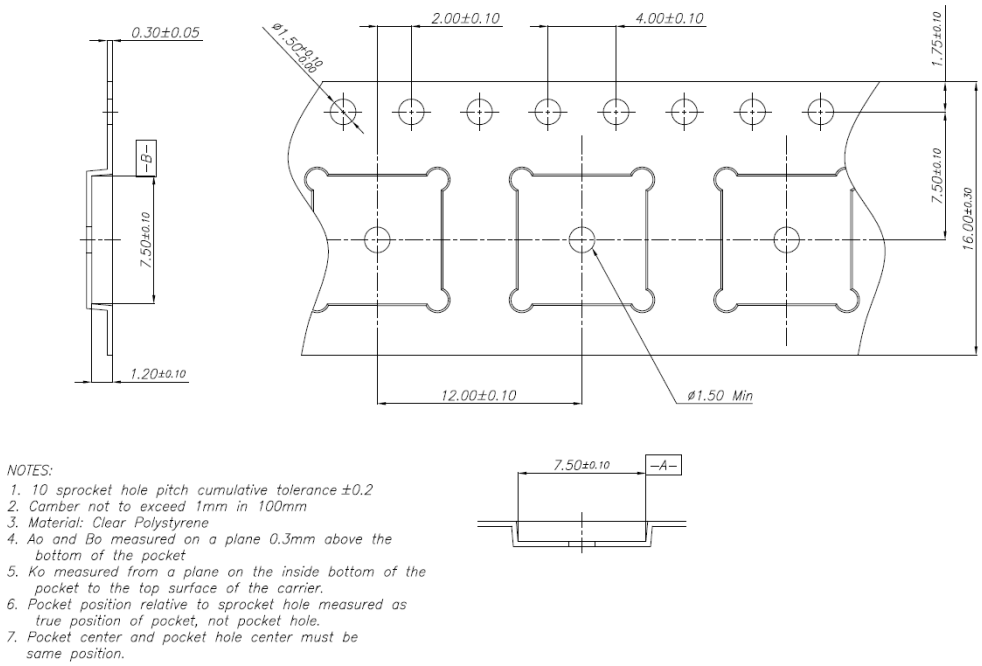


Figure 6: EVA-M8M tape dimensions

6.2 Moisture Sensitivity Levels

The Moisture Sensitivity Level (MSL) relates to the packaging and handling precautions required. EVA-M8M modules are rated at MSL level 3.

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

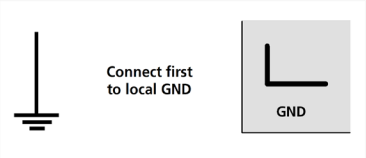
For more information regarding MSL see the *u-blox Package Information Guide* [3].

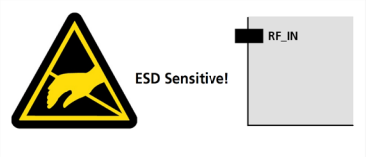
6.3 ESD handling precautions

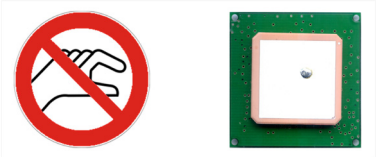
EVA-M8M positioning modules contain highly sensitive electronic circuitry and are Electrostatic Sensitive Devices (ESD). Observe precautions for handling! Failure to observe these precautions can result in severe damage to the GNSS receiver!

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

- Unless there is a galvanic coupling between the local GND (i.e. the work table) and the PCB GND, 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 ~50-80 pF/m, soldering iron, …)
- To prevent electrostatic discharge through the RF input, do not touch any exposed antenna area. If there is any risk that such exposed antenna area is touched in non ESD protected work area, implement proper ESD protection measures in the design.
- When soldering RF connectors and patch antennas to the receiver's RF pin, make sure to use an ESD safe soldering iron (tip).







7 Default messages

Interface	Settings
UART Output	9600 Baud, 8 bits, no parity bit, 1 stop bit Configured to transmit both NMEA and UBX protocols, but only the following NMEA (no UBX) messages have been activated at start-up: **GGA, GLL, GSA, GSV, RMC, VTG, TXT**
USB Output	Configured to transmit both NMEA and UBX protocols, but only the following NMEA (no UBX) messages have been activated at start-up: **GGA, GLL, GSA, GSV, RMC, VTG, TXT** USB Power Mode: Bus Powered
UART Input	9600 Baud, 8 bits, no parity bit, 1 stop bit, Autobauding disabled Automatically accepts following protocols without need of explicit configuration: UBX, NMEA, RTCM The GNSS receiver supports interleaved UBX and NMEA messages.
USB Input	Automatically accepts following protocols without need of explicit configuration: UBX, NMEA, RTCM The GNSS receiver supports interleaved UBX and NMEA messages. USB Power Mode: Bus Powered

Table 14: Default messages

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

8 Labeling and ordering information

8.1 Product labeling

The labeling of u-blox M8 GNSS modules includes important product information. The location of the EVA-M8M product type number is shown in Figure 7.

Pin 1 Marking

U-BLOX
EVAM8Mx00 = Product identification
EVAM8M000 stands for product type number: EVA-M8M-0-00
EVAM8M100 stands for product type number: EVA-M8M-1-00
T-Rff00SS = Revision
LLLLLLL = Lot number
YYWWZZX = Production date code

Figure 7: Description of EVA-M8M product label

8.2 Explanation of product codes

Three different product code formats are used. The **Product Name** is used in documentation such as this data sheet and identifies all u-blox M8 products, independent of packaging and quality grade. The **Ordering Code** includes packaging and quality, while the **Type Number** includes the hardware and firmware versions. Table 15 below details these three different formats:

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

Table 15: Product code formats

The parts of the product code are explained in Table 16.

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

Table 16: Part identification code

8.3 Ordering codes

Ordering No.	Product
EVA-M8M-0	u-blox M8 GNSS LGA Module, crystal, ROM, green, 7.0x7.0 mm, 500 pcs/reel (Default: GPS + GLONASS)
EVA-M8M-1	u-blox M8 GNSS LGA Module, crystal, ROM, green, 7.0x7.0 mm, 500 pcs/reel (Default: GPS + BeiDou)

Table 17: Product ordering codes for professional grade positioning modules

☞ Product changes affecting form, fit or function are documented by u-blox. For a list of Product Change Notifications (PCNs) see our website at: http://www.u-blox.com/en/notifications.html.

Related documents

[1] EVA-M8M Hardware Integration Manual, Docu. No. UBX-14006179

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

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

☞ For regular updates to u-blox documentation and to receive product change notifications please register on our homepage.

Revision history

Revision	Date	Name	Status / Comments
R01	30-Sep-2014	julu	Advance Information
R02	03-Nov-2014	julu	Added product grade information to product selector table (section 1.3).
R03	10-Dec-2014	julu	Early Production Information. Updated Figure 6 (Tape dimensions) and changed Reel size to Type D (section 6.1.1).
R04	27-Apr-2015	julu	Production Information

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