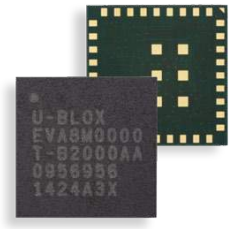
EVA-8M

u-blox 8 GNSS module

Data Sheet



Abstract

Technical data sheet describing the EVA-8M module, which provides single GNSS reception (GPS or GLONASS). EVA-8M is a highly integrated module in a 7x7 mm package. It is pin-compatible to EVA-7M.

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1 Functional description

1.1 Overview

The EVA-8M GNSS module features the exceptional performance of the u-blox 8 positioning engine (receiving GPS, GLONASS, QZSS and SBAS signals). The EVA-8M series modules deliver high sensitivity and minimal acquisition times in the ultra-compact EVA form factor.

The EVA-8M GNSS module supports advanced Power Save Modes and provides message integrity protection, geofencing, spoofing detection and odometer functionalities.

The EVA-8M GNSS module 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-8M GNSS module is especially designed to ease the customer's design and limit near field interferences, since RF and digital domains are kept separated.

The EVA-8M GNSS module uses a crystal oscillator for lower system costs. Like other u-blox GNSS modules, the EVA-8M GNSS module uses components selected for functioning reliably in the field over the full operating temperature range.

The EVA-8M GNSS module can be easily integrated in manufacturing, thanks to the QFN-like package. The module is available in 500 pieces per 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-8M GNSS module perfectly suited for very small and cost-sensitive industrial and wearable devices. The DDC (I2C compliant) interface provides connectivity and enables synergies with most u-blox cellular modules.

The EVA-8M modules are manufactured in ISO/TS 16949 certified sites and qualified as stipulated in the JESD47 standard. By offering backward compatibility to EVA-7M, migration to EVA-8M is easy.

1.2 Product features

Model	Category				GNSS					Supply	Interfaces				Features										Grade		
	Standard Precision GNSS	High Precision GNSS	Dead Reckoning	Timing	GPS / QZSS	GLONASS	Galileo	BeiDou	Number of concurrent GNSS	1.65 V – 3.6 V	UART	USB	SPI	DDC (I²C compliant)	Programmable (flash)	Data logging	Additional SAW	Additional LNA	RTC crystal	Oscillator	Built-in antenna	Built-in antenna supply and supervisor	Timepulse	Standard	Professional	Automotive
EVA-8M	•				•	•			1	•	•	•	•	•		E			♦	C			1		•	

E = External flash required
♦ = Optional, or requires external components
C = Crystal

1.3 Performance

Parameter	Specification			
Receiver type	72-channel u-blox 8 engine GPS L1C/A, SBAS L1C/A, QZSS L1C/A, GLONASS L1OF			
Accuracy of time pulse signal	RMS 99%	30 ns 60 ns		
Frequency of time pulse		0.25 Hz...10 MHz (configurable)		
Operational limits [1]	Dynamics	≤ 4 g		
	Altitude	50,000 m		
	Velocity	500 m/s		
Velocity accuracy [2]		0.05m/s		
Heading accuracy [2]		0.3 degrees		
GNSS		**GPS**	**GLONASS**	
Horizontal position accuracy [3]	**Autonomous** **SBAS**	2.5 m 2.0 m	4.0 m	
Max navigation update rate [4]		18 Hz	18 Hz	
Time-To-First-Fix [5]	Cold start	30 s	31 s	
	Hot start	1 s	1 s	
	Aided starts [6]	3 s	3 s	
Sensitivity [7]	Tracking & Navigation	–164 dBm	–163 dBm	
	Reacquisition	–159 dBm	–156 dBm	
	Cold start	–147 dBm	–146 dBm	
	Hot start	–156 dBm	–155 dBm	

Table 1: EVA-8M performance in different GNSS modes (default: single reception of GPS incl. QZSS, SBAS)

[1] Assuming Airborne < 4 g platform
[2] 50% @ 30m/s
[3] CEP, 50%, 24 hours static, -130 dBm, > 6 SVs
[4] Rates with SBAS and QZSS enabled for > 98% fix report rate under typical conditions
[5] All satellites at -130 dBm
[6] Dependent on aiding data connection speed and latency
[7] Demonstrated with a good external LNA

1.4 Block diagram

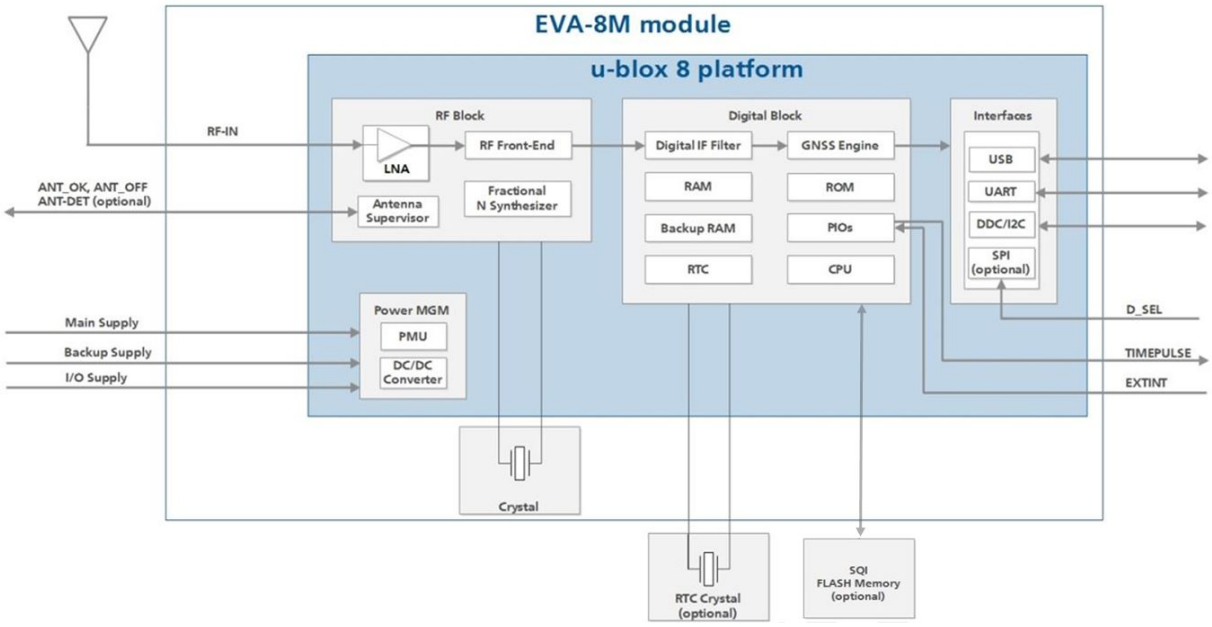

Figure 1: EVA-8M block diagram

1.5 Supported GNSS Constellations

The EVA-8M GNSS module is a single GNSS receiver which can receive and track either GPS or GLONASS signals. By default the receivers is configured for GPS, including SBAS and QZSS reception.

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

1.5.1 GPS

The EVA-8M GNSS module is designed to receive and track the L1C/A signals provided at 1575.42 MHz by the Global Positioning System (GPS). The EVA-8M GNSS module can receive and process GPS concurrently with QZSS and SBAS signals.

1.5.2 GLONASS

The EVA-8M GNSS module can receive and process the GLONASS satellite system as an alternative to GPS. It is designed to receive and track the L1OF signals GLONASS provides at 1602 MHz + k*562.5 kHz, where k is the satellite's frequency channel number (k = –7,..., 5, 6). The ability to process 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-8M / EVA-M8 Hardware Integration Manual [1] for u-blox design recommendations.

1.6 Assisted GNSS (A-GNSS)

Supply of GNSS receiver assistance information, such as ephemeris, almanac, rough user position and time, will reduce the time to first fix significantly and improve acquisition sensitivity The EVA-8M GNSS module supports the u-blox AssistNow Online and AssistNow Offline A-GNSS services, support AssistNow Autonomous, and are OMA SUPL compliant.

1.6.1 AssistNow™ Online

With AssistNow Online, an Internet connected host downloads assistance data from the u-blox AssistNow Online service to the receiver at system start-up. The Multi-GNSS Assistance (MGA) service is an HTTP protocol based network operator independent service.

Supplying assistance information, such as ephemeris, almanac, a rough last position and time, can reduce the time to first fix significantly and improve acquisition sensitivity.

☞ The AssistNow Online service provides data for GPS, GLONASS, and QZSS

1.6.2 AssistNow™ Offline

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

☞ AssistNow Offline service provides data for GPS and GLONASS.

1.6.3 AssistNow™ Autonomous

AssistNow Autonomous operation provides aiding information without the need for a host or external network connection. Based on previous broadcast satellite ephemeris data downloaded to and stored by the GNSS receiver, AssistNow Autonomous automatically generates accurate predictions of satellite orbital data ("AssistNow Autonomous data") that is usable for future GNSS position fixes. The concept capitalizes on the periodic nature of GNSS satellites orbits by capturing strategic ephemeris data at specific times of the day, For EVA-8M GNSS modules, AssistNow Autonomous can calculate GPS only orbit predictions for up to 3 days.

AssistNow Autonomous benefits are:

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

☞ The ROM-based EVA-8M receivers can use AssistNow Autonomous to calculate GPS-only orbit predictions for up to 3 days. For best AssistNow Autonomous performance, it is recommended to utilize the SQI flash interface available in the EVA-8M for data storage.

☞ For more details on A-GNSS, see the u-blox 8 / u-blox M8 Receiver Description Including Protocol Specification [2].

1.7 Augmentation systems

1.7.1 Satellite-Based Augmentation System (SBAS)

The u-blox EVA-8M GNSS module supports reception of SBAS broadcast signals. These systems supplement GNSS data with additional regional or wide area GPS augmentation data. The system broadcasts range correction and integrity information via satellite which can be used by GNSS receivers to improve resulting precision. SBAS satellites can be used as additional signals for ranging (navigation), further enhancing availability. The following SBAS types are supported: EGNOS, MSAS, and WAAS.

For more details, see the u-blox 8 / u-blox M8 Receiver Description Including Protocol Specification [2].

1.7.2 QZSS

The Quasi-Zenith Satellite System (QZSS) is a regional navigation satellite system that transmits additional GPS L1 C/A signals for the Pacific region covering Japan and Australia. EVA-8M GNSS module is able to receive and track these signals concurrently with GPS signals, resulting in better availability especially under challenging signal conditions, e.g. in urban canyons.

The L1-SAIF signal provided by QZSS is not supported

1.7.3 Differential GPS (D-GPS)

u-blox receivers support differential GPS data according to RTCM 10402.3 [4]. The use of differential GPS data improves GPS position accuracy. 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

RTCM correction cannot be used together with SBAS.

For more information, see the u-blox 8 / u-blox M8 Receiver Description Including Protocol Specification [2].

1.8 Odometer

The odometer function provides information on travelled ground distance (in meters) based on the position and Doppler-based velocity output from the navigation solution. For each computed 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 information, see the u-blox 8 / u-blox M8 Receiver Description Including Protocol Specification [2].

1.9 Broadcast navigation data and satellite signal measurement

u-blox 8 receivers can output all the GNSS broadcast data upon reception from tracked satellites. This includes all the supported GNSS signals plus the augmentation services SBAS and QZSS. The receiver also makes available the tracked satellite signal information, i.e. raw code phase and Doppler measurements in a form aligned to the ETSI mobile cellular location services protocol (RRLP) [6].

1.10 Data logging

The EVA-8M module 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 (at least 16 Mbit). It can also log the distance from the odometer. The information can be downloaded from the receiver later for further analysis or for conversion to a mapping tool.

☞ For more information, see the u-blox 8 / u-blox M8 Receiver Description Including Protocol Specification [2].

1.11 Geofencing

The u-blox EVA-8M GNSS module supports up to four circular Geofencing areas defined on the Earth's surface using a 2D model. Geofencing is active when at least one Geo-fence is defined, the current status can be found by polling the receiver. A GPIO pin can be nominated to indicate status to e.g. wake up a host on activation.

1.12 Message Integrity Protection

The EVA-8M GNSS module provides a function to detect third party interference with the UBX message steam sent from receiver to host. The security mechanism 'signs' nominated messages via a subsequent UBX message. This message signature is then compared with one generated by the host to determine if the message data has been altered. The signature algorithm seed can use one fixed secret ID-key set by eFuse in production and a dynamic ID-key set by the host, enabling users to detect 'man-in-the-middle' style attacks.

1.13 Spoofing detection

Spoofing is a process whereby a malicious third party tries to control the reported position via a 'fake' GNSS broadcast signal. This may result in the form of reporting incorrect position, velocity or time. To combat against this, the EVA-8M GNSS module includes spoofing detection measures to alert the host when signals appear to be suspicious. The receiver combines a number of checks on the received signals looking for inconsistencies across several parameters.

☞ This feature does not guarantee to detect all spoofing attacks.

1.14 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 8 / u-blox M8 Receiver Description including Protocol Specification [2] and the EVA-8M / EVA-M8 Hardware Integration Manual [1].

1.14.1 Pin control

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

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

1.14.2 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.

1.15 TIMEPULSE

A configurable time pulse signal is available with u-blox EVA-8M GNSS module.

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 8 / u-blox M8 Receiver Description including Protocol Specification [2].

1.16 Protocols and interfaces

Protocol	Type
NMEA 0183, version 4.0 (V2.3 or V4.1 configurable)	Input/output, ASCII,
UBX	Input/output, binary, u-blox proprietary
RTCM	Input, 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 8 / u-blox M8 Receiver Description Including Protocol Specification [2].

1.17 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.

1.17.1 UART

The EVA-8M GNSS module makes 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 8 / 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.

1.17.2 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 **VDD_USB** pin supplies the USB interface. The u-blox USB (CDC-ACM) driver supports Windows Vista plus Windows 7 and 8 operating systems. A separate driver (CDC-ACM) is not required for Windows 10 which has a built-in USB-serial driver. However, plugging initially into an internet connected Windows 10 PC, will down-load the u-blox combined sensor and VCP driver package.

USB drivers can be down-loaded from the u-blox web site, www.u-blox.com.

1.17.3 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 125 kB/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 1.17.6). In this case the DDC interface for data communication is no longer available.

1.17.4 Display Data Channel (DDC)

An I²C 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 I²C industry standard. Since the maximum SCL clock frequency is 400 kHz, thus the maximum transfer rate is 400 kbit/s.

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

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

1.17.5 Serial Quad Interface (SQI)

An SQI interface is available in the EVA-8M GNSS module for connecting the modules with an optional external flash memory. The flash memory is required for data logging. In addition, it can be used to store receiver configurations and to save AssistNow Offline and AssistNow Autonomous data.

☞ For more information, see the EVA-8M / EVA-M8 Hardware Integration Manual [1].

1.17.6 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-8M modules can communicate to a host via SPI.

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

Table 4: Data interface selection by D_SEL

1.18 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 the EVA-8M GNSS module:

Selection of either DDC or UART TXD/RXD pins interface using D_SEL pin. See section 1.17.6.

Selection of antenna supervision pins. See section 1.23.

Selection of external interrupt pins. See section 1.14.

Configuration of Timepulse. See section 1.15.

☞ For more information, see the EVA-8M / EVA-M8 Hardware Integration Manual [1].

1.19 Safe Boot Mode

If Pin33 (**SAFEBOOT_N**) is set to logical “0” at startup, the EVA-8M GNSS module 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-8M / EVA-M8 Hardware Integration Manual [1].

1.20 System reset

The EVA-8M GNSS module 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.

1.21 Clock generation

1.21.1 Oscillator

The EVA-8M GNSS module uses a 26 MHz crystal oscillator for lower system costs. Like other u-blox GNSS modules, the EVA-8M GNSS module uses components selected for functioning reliably in the field over the full operating temperature range.

1.21.2 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.

☞ See Table 8 for details of RTC voltage requirements when using an optional RTC.

☞ For more information about crystal operation and configuration, see the EVA-8M / EVA-M8 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**.

1.22 Power Management

u-blox 8 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.

1.22.1 DC-DC converter

EVA-8M GNSS module integrates 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-8M / EVA-M8 Hardware Integration Manual [1].

1.22.2 Power Mode Setup

The u-blox EVA-8M GNSS module can be configured to run in either continuous or a choice of Power Save mode configurations. A template of power mode settings can be used to easily select typical power mode setups to cover the majority of users' requirements.

For specific power saving applications the user has the option to fully configure via the power save mode configuration. For more information, see section 1.22.2.2.

The u-blox 8 receivers' power mode setup offers a choice of continuous operation and preset Power Save Mode Configurations:

- Continuous (default) mode for best GNSS performance vs power consumption
- A 1 Hz cyclic tracking mode for aggressive power reduction
- Choice of 2 or 4 Hz cyclic tracking modes for typical wearable applications
- ON/OFF interval mode

1.22.2.1 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

1.22.2.2 Power Save Mode

For power sensitive applications, u-blox 8 receivers provide a Power Save Mode for reduced power consumption.

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

☞ For more information about power management strategies, see the u-blox 8 / u-blox M8 Receiver Description Including Protocol Specification [2].

1.23 Antenna

The EVA-8M module is designed for use with passive [8] and active [9] antennas.

Parameter	Specification	
Antenna type	Passive and active antenna	For passive antenna, an external LNA and SAW 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-8M GNSS module

[8] For integration EVA-8M module with Cellular products, see the EVA-8M / EVA-M8 Hardware Integration Manual [1].
[9] For information on using active antennas with EVA-8M module, see the EVA-8M / EVA-M8 Hardware Integration Manual [1].

1.23.1 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-8M modules.

☞ **ANT_OFF** pin polarity can be changed. For more information about active antenna control, see the EVA-8M / EVA-M8 Hardware Integration Manual [1].

1.23.2 Active antenna supervisor and short circuit detection

An antenna supervisor is available with the EVA-8M GNSS module 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-8M / EVA-M8 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-8M / EVA-M8 Hardware Integration Manual [1].

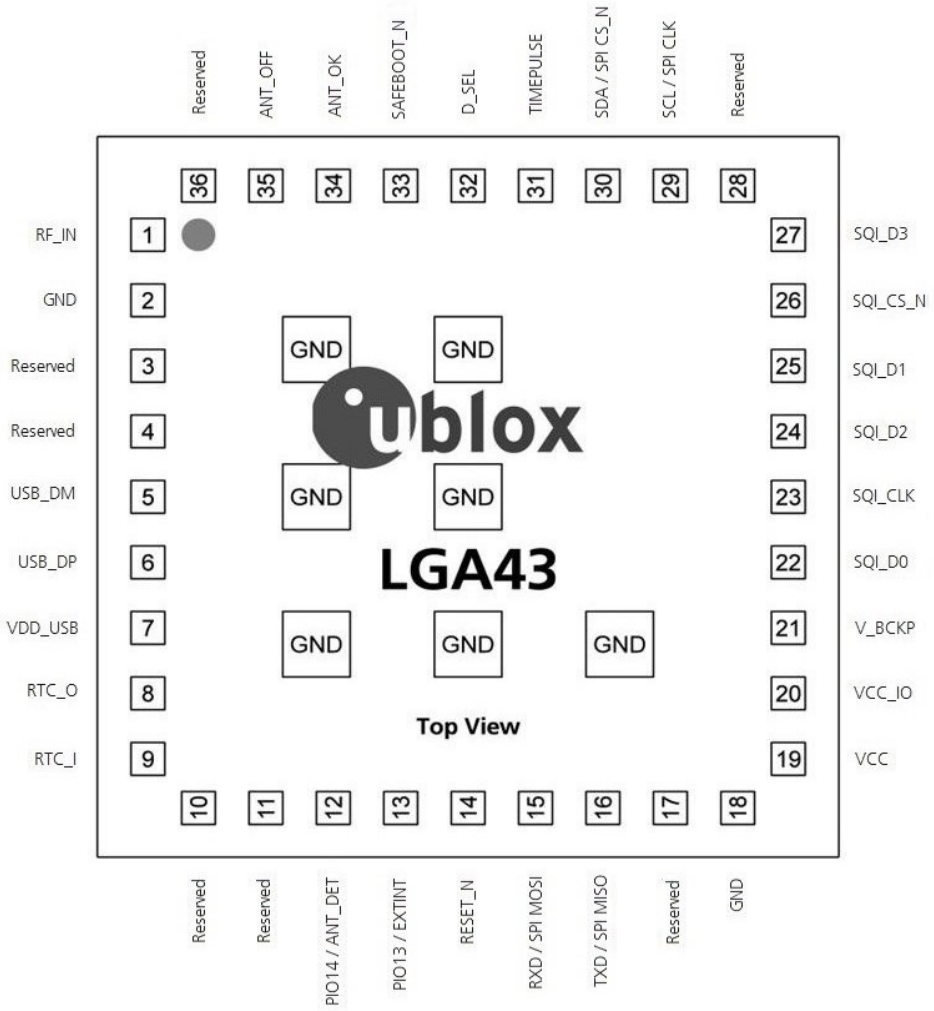

Figure 2: Pin assignment of EVA-8M GNSS module

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

Pin #	Name	I/O	Description	Remark
1	RF_IN	I	RF Input	Add external LNA and SAW if no active antenna used.
2	GND	I	Ground	
3	Reserved	I/O	Reserved	Do not connect. Must be left open!
4	Reserved	I/O	Reserved	Do not connect. Must be left open!

5	USB_DM	I/O	USB data	Leave open if not used.
6	USB_DP	I/O	USB data	Leave open if not used.
7	VDD_USB	I	USB Interface power	Connect to GND if not 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.
10	Reserved	I/O	Reserved	Do not connect. Must be left open!
11	Reserved	I/O	Reserved	Do not connect. Must be left open!
12	PIO14 / ANT_DET	I	Antenna detection	Leave open if not used.
13	PIO13 / EXTINT	I	External interrupt	Leave open if not used.
14	RESET_N	I	System reset	See section 1.19.
15	RXD / SPI MOSI	I	Serial interface	See section 1.17.6.
16	TXD / SPI MISO	O	Serial interface	See section 1.17.6.
17	Reserved	I/O	Reserved	Do not connect. Must be left open!
18	GND	I	Ground	
19	VCC	I	Main supply	
20	VCC_IO	I	I/O Supply	
21	V_BCKP	I	Backup supply	
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_N	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!
29	SCL / SPI CLK	I	Serial interface	See section 1.17.6.
30	SDA / SPI CS_N	I/O	Serial interface	See section 1.17.6.
31	TIMEPULSE	O	Time pulse output	Leave open if not used.
32	D_SEL	I	Interface selector	See section1.17.6.
33	SAFEBOOT_N	I	Used for programming the SQI flash memory and testing purposes.	Leave open if not used.
34	ANT_OK	I	Antenna status	Leave open if not used.
35	ANT_OFF	O	Antenna control	Leave open if not used.
36	Reserved	I/O	Reserved	Do not connect. Must be left open!
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

Table 6: EVA-8M GNSS module pinout

2.2 Pin name changes

Selected pin names have been updated to agree with a common naming convention across u-blox modules. The pins have not changed their operation and are the same physical hardware but with updated names. The table below lists the pins that have changed name along with their old and new names.

No	Previous Name	New name
7	V_USB	VDD_USB
15	RX / MOSI	RXD / SPI MOSI
16	TX / MISO	TXD / SPI MISO
26	SQI_CS	SQI_CS_N
29	SCL / SCK	SCL / SPI CLK
30	SDA / CS_N	SDA / SPI CS_N

Table 7: Pin name changes

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-8M / EVA-M8 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
VDD_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	VCC_IO+0.5 3.6 if VCC_IO > 3.1 V	V
Prfin	RF Input power on RF_IN		+15	dBm
Ptot	Total power dissipation		500	mW
Ts	Storage temperature	–40	+105	°C

Table 8: 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 9 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	
VDD_USB	Supply voltage USB		3.3		V	
NFtot	Receiver Chain Noise Figure		5.0		dB	

Table 9: 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-8M / EVA-M8 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
VDD_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 10: 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 TXD/SPI MISO, RXD/SPI MOSI , SDA/SPI CS_N, SCL/SPI CLK, D_SEL, TIMEPULSE, PIO13/EXTINT, PIO14/ANT_DET, ANT_OK, ANT_OFF	Iol = 4 mA			0.4	V
Voh	High level output voltage for TXD/SPI MISO, RXD/SPI MOSI , SDA/SPI CS_N, SCL/SPI CLK, 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/SPI CS_N, SCL/SPI CLK, TIMEPULSE, PIO13/EXTINT, PIO14/ANT_DET, RESET_N			11		kΩ
Rpu	Pull-up resistor for TXD/ SPI MISO, RXD/SPI MOSI, D_SEL, ANT_OK, ANT_OFF			115		kΩ

Table 11: Digital IO pins

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
Ileak	Leakage current input pins				1	µA
Vil	Low level input voltage	VDD_USB >= 3.0 V	0		0.8	V
Vih	High level input voltage	VDD_USB >= 3.0 V	2.0		VDD_USB	V
Vol	Low level output voltage	R_L = 1.425 kΩ to VDD_USB, VDD_USB >= 3.0 V, 27 Ω external series resistor			0.3	V
Voh	High level output voltage	R_L = 14.25 kΩ to GND, VDD_USB >= 3.0, 27 Ω external series resistor	2.8			V
Rpui	Pull-up resistor, Idle State		870	900	950	Ω
Rpuo	Pull-up resistor, Operational State		1400	1490	1600	Ω

Table 12: USB pins

3.2.2 Baseband parameters

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
RTC_Fxtal	RTC crystal resonant frequency			32768		Hz
RTC_T_start	RTC startup time		0.2	0.35	0.9	sec
RTC_Amp	32768 Hz OSC oscillation amplitude		50		350	mVpp
RTC_ESR	32768 Hz Xtal equivalent series resistance				100	kΩ
RTC_CL	RTC integrated load capacitance	ESR = 80 kΩ	4	7	12	pF

Table 13: Baseband parameters

3.3 Indicative power requirements

Table 14 lists examples of the total system supply current for a possible application.

☞ The values in Table 14 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, the number of SVs tracked, signal strength, type of start as well as time, duration and conditions of test.

Parameter	Symbol	Conditions	Typ GPS / QZSS /SBAS	Typ GLONASS	Max	Units
Max. supply current [10]	Iccp				67	mA
Average supply current [11]	Icc Acquisition [12]	VCC_IO = VCC = 3 V	18	17		mA
	Icc Tracking (Continuous mode)	VCC_IO = VCC = 3 V	16	16		mA
	Icc Tracking (Power Save mode / 1 Hz)	VCC_IO = VCC = 3 V	3.7	3.6		mA
Backup battery current [13]	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 14: Currents to calculate the indicative power requirements

For more information about power requirements, see the EVA-8M / EVA-M8 Hardware Integration Manual [1].

[10] Use this figure to dimension maximum current capability of power supply. Measurement of this parameter with 1 Hz bandwidth.
[11] Simulated constellation of 8 satellites is used. All signals are at -130 dBm. VCC= 3 V
[12] Average current from start-up until the first fix.
[13] Use this figure to determine required battery capacity.

All values in Table 14 are measured at +25 °C ambient temperature.

For more information on how to noticeably reduce current consumption, see the Power Management Application Note [5].

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 15: Symbol description

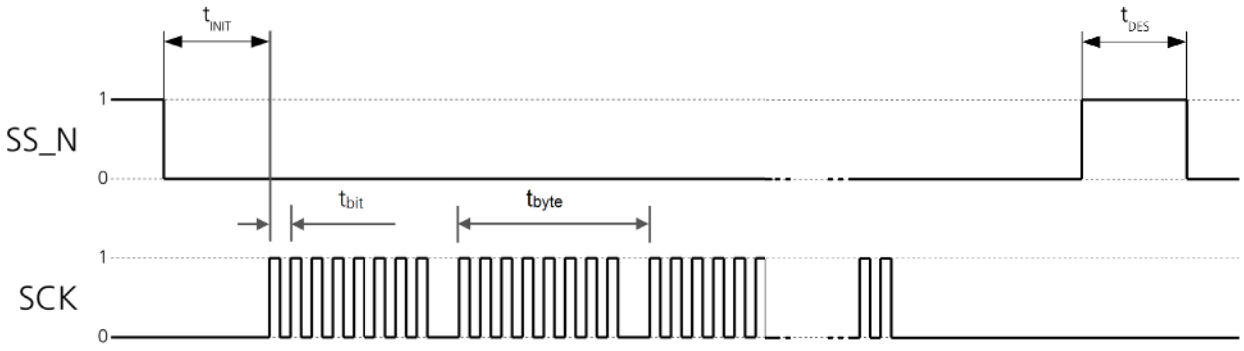

Figure 3: SPI timing diagram

3.4.1 Timing recommendations

The SPI timing recommendations are given below.

Parameter	Description	Recommendation
t_{INIT}	Minimum Initialization Time	10 µs
t_{DES}	Deselect Time	1 ms.
t_{bit}	Minimum bit time	180 ns (5.5 MHz max bit frequency)
t_{byte}	Minimum byte period	8 µs (125 kHz max byte frequency)

Table 16: 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.

3.5 DCC timing diagrams

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

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

4 Mechanical specification

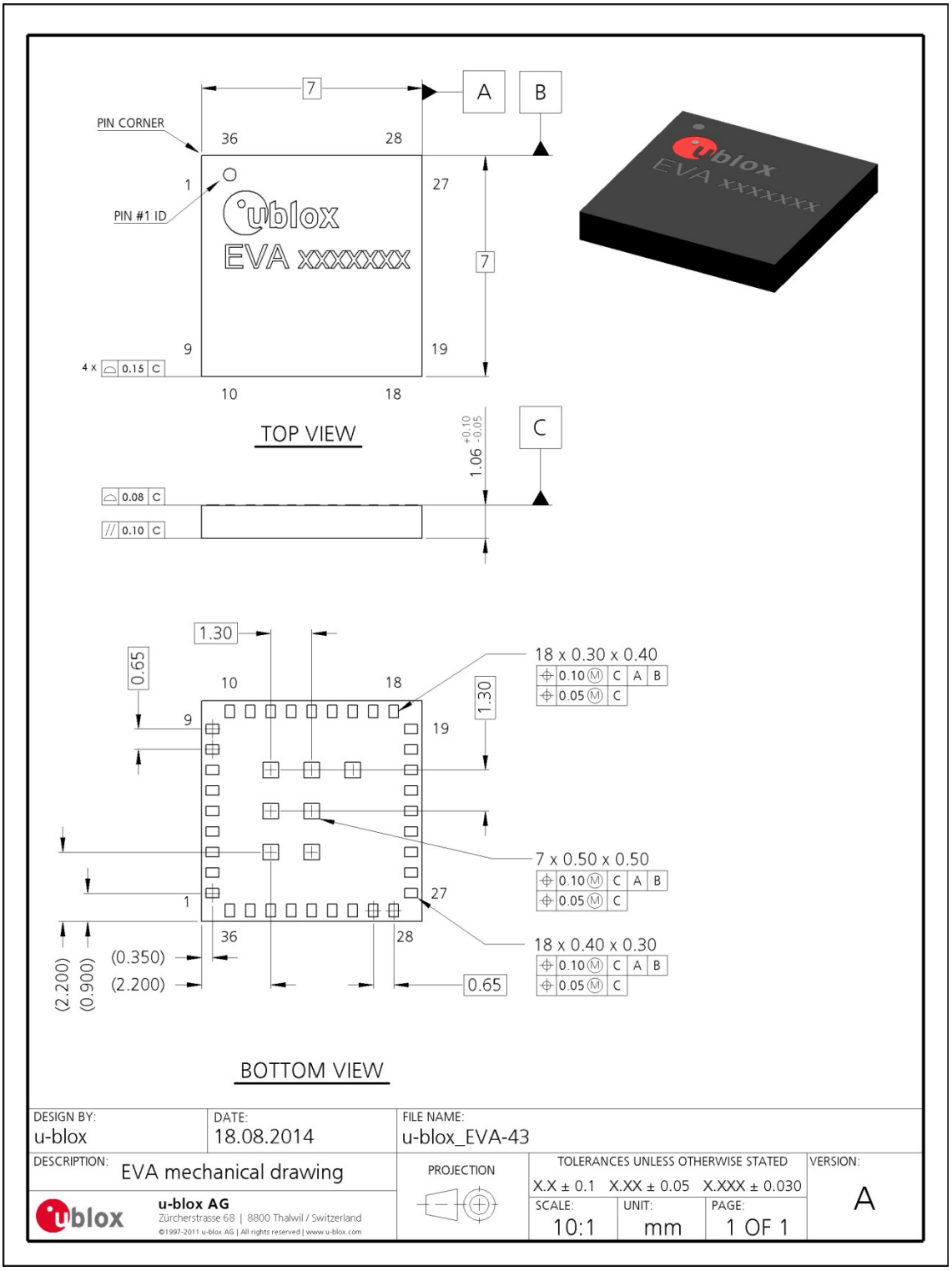

Figure 4: Mechanical drawing for EVA-8M (LGA43)

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

The EVA-8M module complies with the Directives 2011/65/EU and 2015/863/EU of the European Parliament and the Council on the Restriction of Use of certain Hazardous Substances (RoHS).

6 Product handling

6.1 Packaging

EVA-8M GNSS module is 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

Each reel has 500 EVA-8M GNSS modules. The EVA-8M GNSS module is 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-8M 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.

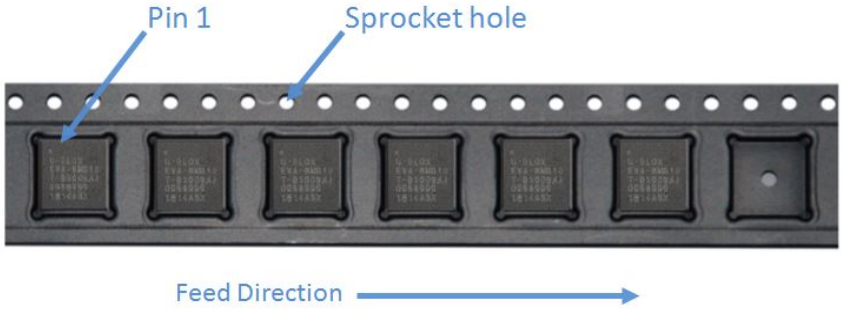

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Figure 5: Orientation of EVA-8M modules on the tape

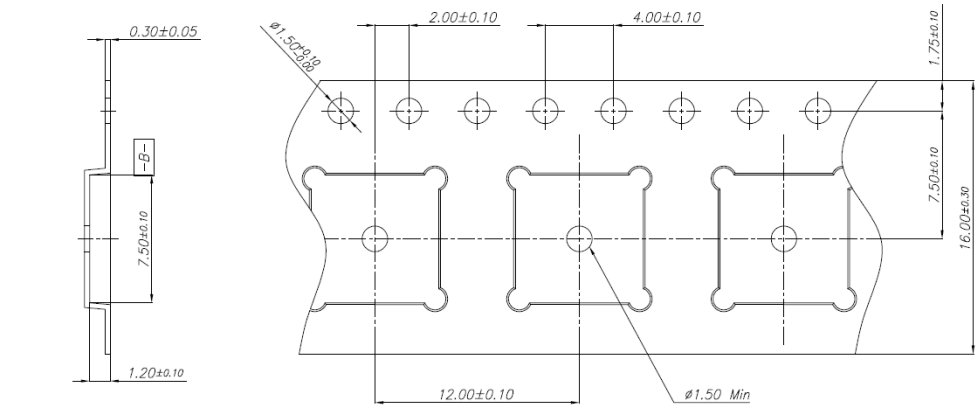

Figure 6: EVA-8M tape dimensions

6.2 Moisture Sensitivity Levels

The Moisture Sensitivity Level (MSL) relates to the packaging and handling precautions required. EVA-8M GNSS module is 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-8M GNSS module is 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
DDC	Fully compatible with the I²C industry standard, available for communication with an external host CPU or u-blox cellular modules, operated in slave mode only. Default messages activated. NMEA and UBX are enabled as input messages, only NMEA as output messages. Maximum bit rate 400 kb/s.
SPI	Allow communication to a host CPU, operated in slave mode only. Default messages activated. SPI is not available in the default configuration.
TIMEPULSE (1 Hz Nav)	1 pulse per second, synchronized at rising edge, pulse length 100 ms

Table 17: Default messages

☞ Refer to the u-blox 8 / u-blox M8 Receiver Description Including Protocol Specification [2] for information about other settings.

8 Labeling and ordering information

8.1 Product labeling

The labeling of u-blox EVA form factor GNSS modules includes important product information. The location of the EVA-8M product type number is shown in Figure 7.

Pin 1 Marking

U-BLOX

EVA-8M010 = Product identification

EVA8M010 stands for product type number: EVA-8M-0-10

T-Rff00SS = Revision

LLLLLLL = Lot number

Figure 7: Description of EVA-8M 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 8 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 18 below details these three different formats:

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

Table 18: Product code formats

The parts of the product code are explained in Table 19.

Code	Meaning	Example
PPP	Product Family	EVA
TG	Technology & Generation	8 = u-blox 8
V	Variant	Function set (A-Z)
N	Option/ Quality Grade	Describes standardized functional element or quality grade 0 = Default variant, A = Automotive
XX	Product Detail	Describes product details or options such as hardware and software revision, cable length, etc.

Table 19: Part identification code

8.3 Ordering codes

Ordering No.	Product
EVA-8M-0	u-blox 8 GNSS LGA Module, crystal, ROM, 7.0x7.0 mm, 500 pcs/reel

Table 20: 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.

Related documents

[1] EVA-8M / EVA-M8 Hardware Integration Manual, Doc. No. UBX-16010593
[2] u-blox 8 / u-blox M8 Receiver Description Including Protocol Specification (Public version), Doc. No. UBX 13003221
[3] u-blox Package Information Guide, Doc. No. UBX-14001652
[4] RTCM 10402.3 Recommended Standards for Differential GNSS, Ver. 2.3, RTCM AUG. 20, 2001
[5] Power Management Application Note, Doc. No. UBX-13005162
[6] Radio Resource LCS Protocol (RRLP), (3GPP TS 44.031 version 11.0.0 Release 11)

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

Revision history

Revision	Date	Name	Comments
R01	02-May-2016	njaf	Objective Specification status
R02	09-Jun-2016	njaf	Advance Information status
R03	28-Jul-2016	njaf	Production Information
R04	25-Feb-2019	mbab, jesk	Updated AssistNow Autonomous compatibility in section 1.6.3. Updated Absolute maximum rating in section 3.1. Updated RoHS directives in section 5.2. Reformat

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