	E-1612-UB
	Ultra High Sensitivity and Low Power
	GPS Receiver Module

General Description

The E-1612-UB module series is a family of stand-alone GPS receivers featuring the high performance u-blox 5 positioning engine. These flexible and cost effective receivers offer numerous connectivity options in a miniature 16 x 12.2 x 2.4mm package. Their compact architecture and power and memory options make E-1612-UB modules ideal for battery operated mobile devices with very strict cost and space constraints.

The 50-channel u-blox 5 positioning engine boasts a Time-To-First-Fix (TTFF) of under 1 second. The dedicated acquisition engine, with over 1 million correlators, is capable of massive parallel time/frequency space searches, enabling it to find satellites instantly. Innovative design and technology suppresses jamming sources and mitigates multipath effects, giving E-1612-UB GPS receivers excellent navigation performance even in the most challenging environments.

E-1612-UB modules are not designed for life saving or supporting devices or for aviation and should not be used in products that could in any way negatively impact the security or health of the user or third parties or that could cause damage to goods.

Applications

- LBS (Location Based Service)
- Mobile phone
- PND (Portable Navigation Device)
- Vehicle navigation system

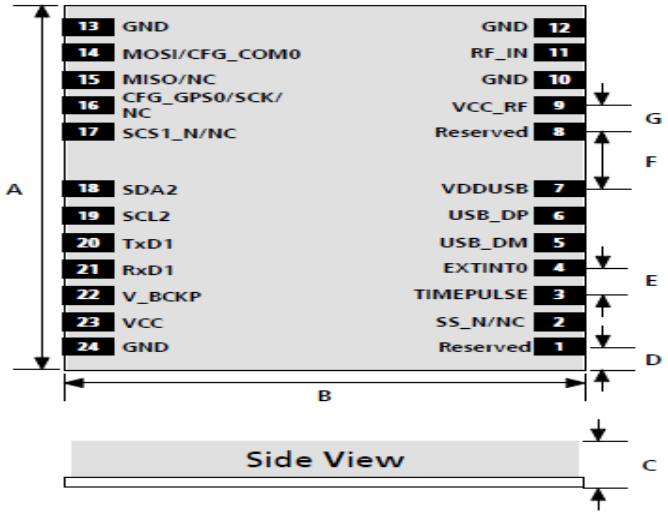
Figure 1: E-1612 -UB Top View

Features

- Build on high performance, low-power UB-5010 chipset
- Ultra high sensitivity: -160dBm
- Extremely fast TTFF at low signal level
- Built in high gain LNA

- Low power consumption: Max 40mA@3.0V
- NMEA-0183 compliant protocol or custom protocol
- Operating voltage: 2.75V to 3.6V
- Operating temperature range: -40 to 85℃
- SMD type with stamp holes
- Small form factor: 16x12.2x2.4mm
- RoHS compliant (Lead-free)

Pin Assignment



Parameter	Specification
A	16.0±0.6/−0.1mm
B	12.2±/−0.1mm
C	2.4±/−0.2mm
D	1.0±0.3/−0.1mm
E	1.1±/−0.1mm
F	3.0±/−0.1mm
G	1.1±/−0.1mm
Weight:	1.6g

Figure 2: E-1612-UB Pin Packag

Performance Specification

Parameter	Specification
Receiver Type	L1 frequency band, C/A code, 50-channels SBAS: WAAS, EGNOS, MSAS, GAGAN
Sensitivity	Tracking -160dBm

	Acquisition	-160dBm
Accuracy	Position	5m CEP without SA
	Velocity	0.1m/s without SA
	Timing (PPS)	10ns RMS
Acquisition Time	Cold Start	29s
	Warm Start	28s
	Hot Start	1s
	Re-Acquisition	<1s
Power Consumption	Tracking	35mA @3V Vcc
	Acquisition	40mA
	Sleep/Standby	TBD
NavigationDataUpdate Rate	1Hz	
Operational Limits	Altitude	Max 18,000m
	Velocity	Max 515m/s
	Acceleration	Less than 4g

Interfaces Configuration

1.1Assisted GPS (A-GPS)

Supply of aiding information like ephemeris, almanac, rough last position and time and satellite status and an optional time synchronization signal will reduce time to first fix significantly and improve the acquisition sensitivity. E-1612-UB modules support the u-blox AssistNow Online and AssistNow Offline A-GPS services8 and are OMA SUPL compliant.

1.2 SuperSense Indoor GPS

E-1612-UBmodulescomewithSuperSense,providingultra-fastacquisition/reacquisitio n and exceptional tracking sensitivity. SuperSense enables best-in-class tracking and navigation in difficult signal environments such as urban canyons or indoor locations.

1.3 KickStart / Oscillators

An available feature is KickStart. This functionality uses a TCXO to accelerate weak signal acquisition, enabling faster start and reacquisition times. KickStart is available with the E-1612-UB.

1.4 Protocols and interfaces

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

Table 3: Available protocols

Both protocols are available on UART, USB, DDC and SPI. For specification of the various protocols see the u-blox_5 Receiver Description including Protocol Specification [2].

E-1612-UB modules support a number of peripheral interfaces for serial communication. The embedded firmware uses these interfaces according to their respective protocol specifications. For specific applications, the firmware also supports the connection of peripheral devices, such as external memories, to some of the interfaces.

1.5UART

E-1612-UB modulesincludeoneconfigurableUARTinterfaceforserial communication (for information about configuration see section 1.11).

1.6USB

E-1612-UBmodules provide a USB version 2.0 FS (Full Speed, 12Mbit/s) interface as an alternative to the UART. The pull-up resistor on USB_DP is integrated to signal a full-speed device to the host. The VDD_USB pin supplies the USB interface, independently from the VDD_IO pin.

u-blox providesaMicrosoft®certifiedUSBdriver for Windows XP and WindowsVista operating systems. Windows 7 will also be supported following certification

. **Operating System**	**Support level**
Windows XP	Certified
Windows Vista	Certified
Windows 7	Certification pending

Table 4: Operating systems supported by USB driver

1.7 Serial Peripheral Interface (SPI)

An SPI interface is planned for future versions of E-1612-UB modules. The SPI interface allows for the connection of external devices with a serial interface, e.g. EEPROM or A/D converters, or to interface to a host CPU. The interface can be operated in master or slave mode. In master mode, one chip select signal is available to select external slaves. In slave mode a single chip select signal enables communication with the host.

1.8 Display Data Channel (DDC)

The I2C compatible DDC interface can be used either to access external devices with a serial interface (e.g. EEPROM or A/D converters) or to interface with a host CPU. It is capable of master and slave operation and communicates at a rate of <100kbit/s.

GPS.

1.9Antenna

E-1612-UB modules are designed for use with passive and active9 antennas.

Parameter		**Specification**
Antenna Type		Passive and active antenna
Active Antenna Recommendations	Minimum gain Maximum noise figure Maximum gain	15 - 20 dB (to compensate signal loss in RF cable) 1.5 dB 50 dB

Table 5: Antenna Specifications for all E-1612-UB modules

2.0Operating modes

E-1612-UB modules have 2 continuous operating modes (Maximum Performance and Eco). Maximum Performance mode freely uses the acquisition engine, resulting in the best possible TTFF, while Eco mode optimizes the use of the acquisition engine to deliver lower current consumption. At medium to strong signals, there is almost no

difference for acquisition and tracking performance in these modes.

2.1Maximum Performance mode

In Maximum Performance mode, u-blox 5 receivers use the acquisition engine at full performance to search for all possible satellites until the Almanac is completely downloaded.

As a consequence, tracking current consumption level will be achieved when:

A valid GPS position is fixed

Almanac is entirely downloaded

Ephemeris for all satellites in view are valid

2.2Eco mode

In Eco mode, u-blox 5 receivers use the acquisition engine to search for new satellites only when needed for navigation:

In cold starts, u-blox 5 searches for enough satellites to navigate and optimizes use of the acquisition engine to download their ephemeris.

In non-cold starts, u-blox 5 focuses on searching for visible satellites whose orbits are known from the Almanac.

In Eco mode, the u-blox 5 acquisition engine limits use of its searching resources to minimize power consumption. As a consequence the time to find some satellites at weakest signal level might be slightly increased in comparison to the Max. performance mode.

u-blox 5 deactivates the acquisition engine as soon as a position is fixed and a sufficient number (at least 4) of satellites are being tracked. The tracking engine continues to search and track new satellites without orbit information.

2.3 Boot-time configuration

E-1612-UB modules provide configuration pins for boot-time configuration. These become effective immediately after start-up. Once the module has started, the configuration settings may be modified with UBX configuration messages. The modified settings remain effective until power-down or reset. If these settings have been stored in battery-backup RAM, then the modified configuration will be retained, as long as the backup battery supply is not interrupted.

E-1612-UB modules include a **CFG_COM0** pin, which can be configured as seen in Table 6. Default settings in bold.

CFG_COM0	Protocol	Messages	UARTBaud rate	USB Power
1	**NMEA**	**GSV, RMC, GSA, GGA, GLL, VTG, TXT**	**9600**	**BUS Powered10**
0	NMEA	GSV, RMC, GSA, GGA, GLL, VTG, TXT	38400	Self Powered

Table 6: Supported CFG_COM0 settings

E-1612-UBinclude both **CFG_COM0** and **CFG_COM1** pins and can be configured as seen in Table 7. Default settings in bold.

CFG_COM1	CFG_COM0	Protocol	Messages	UARTBaud rate	USB power
1	**1**	**NMEA**	**GSV, RMC, GSA, GGA, GLL, VTG, TXT**	**9600**	**BUS Powered**
1	0	NMEA	GSV, RMC, GSA, GGA, GLL, VTG, TXT	38400	Self Powered
0	1	NMEA	GSV10, RMC, GSA, GGA, VTG, TXT	4800	BUS Powered
0	0	UBX	NAV-SOL, NAV-STATUS, NAV-SVINFO, NAV-CLOCK, INF, MON-EXCEPT	57600	BUS Powered

Table 7: Supported COM settings E-1612-UB

The E-1612-UB include a **CFG_GPS0** pin, which enables the boot-time configuration of the power mode. These settings are described in Table 8. Default settings in bold

. **CFG_GPS0**	**Power Mode**
0	Eco Mode
1	**Maximum Performance Mode**

Table 8: Supported CFG_GPS0 settings E-1612-UB

External serial EEPROM

E-1612-UBmodules allow an optional external serial EEPROM to be connected to the DDC interface.

This feature is only supported by modules with ROM 5.0 and above.

Pin Description

Pin No.	Pin name	I/O	Description
1	Reserved	I	Leave Open if not used
2	SS_N	I	SPI Slave Select (Planned)
3	TIMEPULSE	O	Time pulse (1PPS)
4	EXTINT0	I	External Interrupt Pin
5	USB_DM	I/O	USB Data
6	USB_DP	I/O	USB Data
7	VDDUSB	I	USB Supply
8	Reserved		**See Hardware Integration Manual Pin 8 and 9 must be connected together.**
9	VCC_RF	O	**Output Voltage RF section Pin 8 and 9 must be connected together**
10	GND	G	Ground
11	RF_IN	I	GPS Signal Input
12	GND	G	Ground

13	GND	G	Ground
14	MOSI/CFG_COM0	I/O	SPI MOSI / Configuration Pin (Planned)
15	MISO/CFG_COM1	I/O	SPI MISO (Planned) / Configuration Pin. Leave open if not used.
16	CFG_GPS0 SCK	I/O	Power Mode Configuration Pin SPI Clock(Planned)
17	Reserved	0	
18	SDA2	I/O	DDC Data
19	SCL2	I/O	DDC Clock
20	TXD1	O	UART Serial Data Output Pull up (75KΩ) if not used
21	RXD1	I	UART Serial Data Input Pull up (75KΩ) if not used
22	VBAT	P	Backup battery supply voltage
23	VCC	P	DC suppiy voltage
24	GND	G	Ground

Electrical Characteristics

Absolute Maximum Rating

Parameter	Symbol	Min	Max	Units
Power Supply				
Power Supply Volt.	Vcc	-0.3	3.6	V
Input Pins				

Input Pin Voltage I/O	RXD	-0.3	3.6	V
Input Pin Voltage I/O	BOOT	-0.3	3.6	V
Backup Battery	VBAT	2.0	3.6	V
Environment				
Storage Temperature	Tstg	-40	125	˚C
Peak Reflow Soldering Temperature <10s	Tpeak		260	˚C
Humidity			95	%

Note: Absolute maximum ratings are stress ratings only, and functional operation at the maxims is not guaranteed. Stress beyond the limits specified in this table may affect device reliability or cause permanent damage to the device. For functional operating conditions, refer to the operating conditions tables as follow.

Operating Conditions

Parameter	Symbol	Condition	Min	Typ	Max	Units
Power supply voltage	Vcc		2.7	3.3	3.6	V
Power supply voltage ripple	Vcc_PP	Vcc=3.0V			35	mV
Consumption current	Icc	Vcc=3.0V		40	45	mA
Input high voltage	V_{IH}		0.7xVcc		Vcc+1.0	V

Input low voltage	V_{IL}		-0.3		0.3xVcc	V
Output high voltage	V_{OH}		0.8xVcc		Vcc	V
Output low voltage	V_{OL}		0		0.2xVcc	V
Operating temperature	Topr		-40		85	˚C

NMEA 0183 Protocol

The NMEA protocol is an ASCII-based protocol, Records start with a $ and with carriage return/line feed. GPS specific messages all start with $GPxxx where xxx is a three-letter identifier of the message data that follows. NMEA messages have a checksum, which allows detection of corrupted data transfers.

The Gotop E-1612-UB supports the following NMEA-0183 messages: GGA, GLL, GSA, GSV, RMC and VTG.

Table 1: NMEA-0183 Output Messages

NMEA Record	DESCRIPTION
GGA	Global positioning system fixed data
GLL	Geographic position—latitude/longitude
GSA	GNSS DOP and active satellites
GSV	GNSS satellites in view
RMC	Recommended minimum specific GNSS data

VTG	Course over ground and ground speed

GGA-Global Positioning System Fixed Data

Table 2 contains the values of the following example:

$GPGGA, 161229.487,3723.2475,N, 12158.3416,W, 1,07,1.0,9.0,M.0000*18

Table 2: GGA Data Format

Name	Example	Units	Description
Message ID	$GPGGA		GGA protocol header
UTC Position	161229.487		hhmmss.sss
Latitude	3723.24571		ddmm.mmmmm
N/S indicator	N		N=north or S=south
Longitude	12158.34160		ddmm.mmmmm
E/W Indicator	W		E=east or W=west
Position Fix Indicator	1		See Table 2-1
Satellites Used	07		Range 0 to 12
HDOP	1.0		Horizontal Dilution of Precision
MSL Altitude	9.0	meters	
Units	M	meters	
Geoids Separation		meters	

Units	M	meters	
Age of Diff.Corr.		second	Null fields when DGPS is not Used
Diff.Ref.Station ID	0000		
Checksum	*18		
<CR> <LF>			End of message termination

Table 2-1: Position Fix Indicators

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid
2	Differential GPS, SPS Mode, fix valid
3	GPS PPS Mode, fix valid

GLL-Geographic Position – Latitude/Longitude

Table 3 contains the values of the following example:

$GPGLL , 3723.2475, N,12158.3416, W,161229.487, A*2C.

Table 3: GLL Data Format

Name	Example	Units	Description
Message ID	$GPGLL		GLL protocol header

Latitude	3723.24755		Ddmm.mmmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.34161		Ddmm.mmmmm
E/W Indicator	W		E=east or W=west
UTC Position	161229.487		Hhmmss.sss
Status	A		A=data valid or V=data not valid
Checksum	*2C		
<CR> <LF>			End of message temination

GSA-GNSS DOP and Active Satellites

Table 4 contains the values of the following example:

$GPGSA , A, 3, 07, 02, 26,27, 09, 04,15, , , , , , 1.8,1.0,1.5*33.

Table 4: GSA Data Format

Name	Example	Units	Description
Message	$GPGSA		GSA protocol header
Mode 1	A		See Table 4-2
Mode 2	3		See Table 4-1
Satellite Used	07		Sv on Channel 1

Satellite Used	02		Sv on Channel 2
…	…		…
Satellite Used			Sv on Channel 12
PDOP	1.8		Position Dilution of Precision
HDOP	1.0		Horizontal Dilution of Precision
VDOP	1.5		Vertical Dilution of Precision
Checksum	*33		
<CR> <LF>			End of message termination

Table 4-1: Mode 1

Value	Description
1	Fix not available
2	2D
3	3D

Table 4-2: Mode 2

Value	Description
M	Manual-forced to operate in 2D or 3D mode
A	Automatic-allowed to automatically switch 2D/3D

GSV-GNSS Satellites in View

Table 5 contains the values of the following example:

$GPGSV , 2, 1, 07, 07, 79,048, 42, 02, 51,062, 43, 26, 36,256, 42, 27, 27, 138,42*71

$GPGSV, 2, 2, 07, 09, 23,313, 42, 04, 19, 159, 41, 15,12,041, 42*41.

Table 5: GGA Data Format

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
Number of Message	2		Range 1 to 3
Message Number	1		Range 1 to 3
Satellites in View	07		
Satellite ID	07		Channel 1(Range 1 to 32)
Elevation	79	degrees	Channel 1(Maximum 90)
Azinmuth	048	degrees	Channel 1(True, Range 0 to 359)
SNR(C/NO)	42	dBHz	Range 0 to 99,null when not tracking
…			…
Satellite ID	27		Channel 4(Range 1 to 32)
Elevation	27	degrees	Channel 4(Maximum 90)
Azimuth	138	degrees	Channel 4(True, Range 0 to 359)
SNR(C/NO)	42	dBHz	Range 0 to 99, null when not tracking
Checksum	*71		

<CR> <LF>			End of message termination

Depending on the number of satellites tracked multiple messages of GSV data may be required.

RMC-Recommended Minimum Specific GNSS Data

Table 6 contains the values of the following example:

$GPRMC, 161229.487, A, 3723.2475, N, 12158.3416, W, 0.13,309.62, 120598,, *10

Table 6: RMC Data Format

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header
UTS Position	161229.487		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	3723.24751		ddmm.mmmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.34161		Ddmm.mmmmm
E/W Indicator	W		E=east or W=west
Speed Over Ground	0.13	Knots	
Course Over	309.62	Degrees	True
Ground			
Date	120598		Dummy

Magnetic variation		Degrees	E=east or W=west
Checksum	*10		
<CR> <LF>			End of message termination

VTG-Course Over Ground and Ground Speed

Table 7 contains the values of the following example:

$GPVTG, 309.62, T, M, 0.13, N, 0.2, K*6E

Table 7: VTG Data Format

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header
Course	309.62	Degrees	Measured heading
Reference	T		True
Course		Degrees	Measured heading
Reference	M		Magnetic
Speed	0.13	Knots	Measured horizontal speed
Units	N		Knots
Speed	0.2	Km/hr	Measured horizontal speed
Units	K		Kilometer per hour
Checksum	*6E		
<CR> <LF>			End of message termination

RECOMMENDED REFLOW PROFILE