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NEO-5
u-blox 5 ROM-Based GPS Modules

Data Sheet

Abstract

Technical data sheet describing the cost effective, high-performance u-blox 5 based NEO-5 series of GPS modules.

Features include AssistNow Online and AssistNow Offline A-GPS services, KickStart accelerated acquisition, SuperSense® Indoor GPS providing best-in-class acquisition and tracking sensitivity, small size and an innovative jamming-resistant RF architecture.
The miniature 12.2 x 16.0 mm form factor of the highly successful NEO-4S module is maintained, enabling easy migration. NEO-5 modules support passive and active antennas.
The 1.8V NEO-5D and NEO-5G modules provide the exceptional performance of u-blox 5 positioning while enabling power savings in the order of 40%.

your position is our focus

Data Sheet

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Subtitle	u-blox 5 ROM-Based GPS Modules
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Revision Index	Date	Name	Status / Comments
P1	18/08/2007	TG	Initial Version
P2	22/08/2007	TG	
P3	11/04/2008	TG	New Naming, TTFF, Reliability Tests, Ordering Numbers, Power Modes
P4	16/04/2008	TG	EEPROM
P5	23/04/2008	TG	USB
P6	5/05/2008	TG	Thickness
P7	26/06/2008	TG	Power Consumption, Active Antenna Gain
1	7/07/2008	TG	Vbckp, Current Consumption, CI
2	1/10/2008	TG	NEO-5G/D added
3	12/11/2008	TG	Vddusb, CFG pins
4	26/11/2008	TG	RMS, EEPROM, Antenna Gain, Operational Limits

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ARM

Data sheet status	
Objective Specification	This data sheet contains target or goal specification for product development.
Advance Information	This data sheet contains data based on early testing. Values may change.
Preliminary	This data sheet contains preliminary data, revised and supplementary data may be published later.
Released	This data sheet contains the final product specification.

Pb	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).
	This is an Electrostatic Sensitive Device (ESD). Observe precautions for handling.

1 Functional Description

1.1 Overview

The NEO-5 series by u-blox sets a new standard for GPS receiver modules. Powered by the high performance 50-channel u-blox 5 technology, these modules provide excellent performance at an economical price. A 32-channel acquisition engine with over 1 million effective correlators is capable of massive parallel searches across the time/frequency space. This enables a Time To First Fix (TTFF) of less than 1 second while long correlation/dwell times make possible the best-in-class acquisition and tracking sensitivity. An available functionality is KickStart, a new feature enabling accelerated acquisition of weak signals. Once acquired, satellites are passed on to a power-optimized dedicated tracking engine. This arrangement allows the GPS engine to simultaneously track up to 16 satellites while searching for new ones.

u-blox 5's advanced jamming suppression mechanism and innovative RF architecture provides a high level of immunity to jamming, ensuring maximum GPS performance. The miniature 12.2 x 16 mm form factor of the successful NEO-4S module is maintained, permitting easy migration. An I^2C compatible DDC interface is provided to connect an optional external serial E^2PROM to store power-up configuration settings. The 1.8V NEO-5D and NEO-5G modules provide the exceptional performance of u-blox 5 positioning while enabling power savings in the order of 40%.

The NEO-5 series is 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.

1.2 Highlights and Features

Highlights

- 50-channel u-blox 5 engine with over 1 million effective correlators
- <1 second Time To First Fix for Hot and Aided Starts
- -160dBm SuperSense® acquisition and tracking sensitivity
- Accelerated startup at weak signals for modules with KickStart feature
- Supports AssistNow Online and AssistNow Offline A-GPS services; OMA SUPL compliant
- High immunity to jamming
- 4 Hz position update rate
- Miniature 16.0 x 12.2mm package
- UART, USB, DDC and SPI[1] interfaces
- 1.8V supply voltage for low power consumption (NEO-D / NEO-5G)
- RoHS compliant

Features

	Voltage Range (V)	Thickness (mm)	50-channel engine	KickStart	SuperSense	FW Update / FLASH	Low Power Modes	GALILEO	UART	USB	SPI	DDC	AssistNow Online	AssistNow Offline	Dead Reckoning	Raw Data	Precision Timing	1PPS	CFG Pin	Reset Input	Antenna Supply	Antenna Supervisor
NEO-5D	1.8	2.4	✓		✓		P		1	1		1	✓	✓				✓	1			
NEO-5G	1.8	2.4	✓	✓	✓		P		1	1	1	1	✓	✓				✓	3			
NEO-5M	2.7-3.6	2.4	✓		✓		P		1	1		1	✓	✓				✓	1			
NEO-5Q	2.7-3.6	2.4	✓	✓	✓		P		1	1	1	1	✓	✓				✓	3			

P= Planned

Table 1: Features of the NEO-5 Series

[1] NEO-5Q / NEO-5G

1.3 GPS Performance

Parameter	Specification		
Receiver Type		50 Channels GPS L1 frequency, C/A Code	
Time-To-First-Fix[2]		NEO-5G, NEO-5Q	NEO-5D, NEO-5M
	Cold Start (Autonomous)	29 s	32 s
	Warm Start (Autonomous)	29 s	32 s
	Hot Start (Autonomous)	<1 s	<1 s
	Aided Starts[3]	<1 s	<3 s
Sensitivity[4]		NEO-5G, NEO-5Q	NEO-5D, NEO-5M
	Tracking & Navigation	-160 dBm	-160 dBm
	Reacquisition	-160 dBm	-160 dBm
	Cold Start (Autonomous)	-144 dBm	-143 dBm
Horizontal Position Accuracy[5]	Autonomous	< 2.5 m	
	SBAS	< 2.0 m	
Accuracy of Timepulse Signal	RMS	30 ns[6]	
	Time Pulse	Configurable: 0.25 … 1000 Hz	
Max Navigation Update Rate		4 Hz	
Velocity Accuracy [7]		0.1m/s	
Heading Accuracy[7]		0.5 degrees	
Dynamics		≤ 4 g	
Operational Limits	Velocity	600 m/s	

Table 2: NEO-5 GPS Performance

1.4 Block Diagram

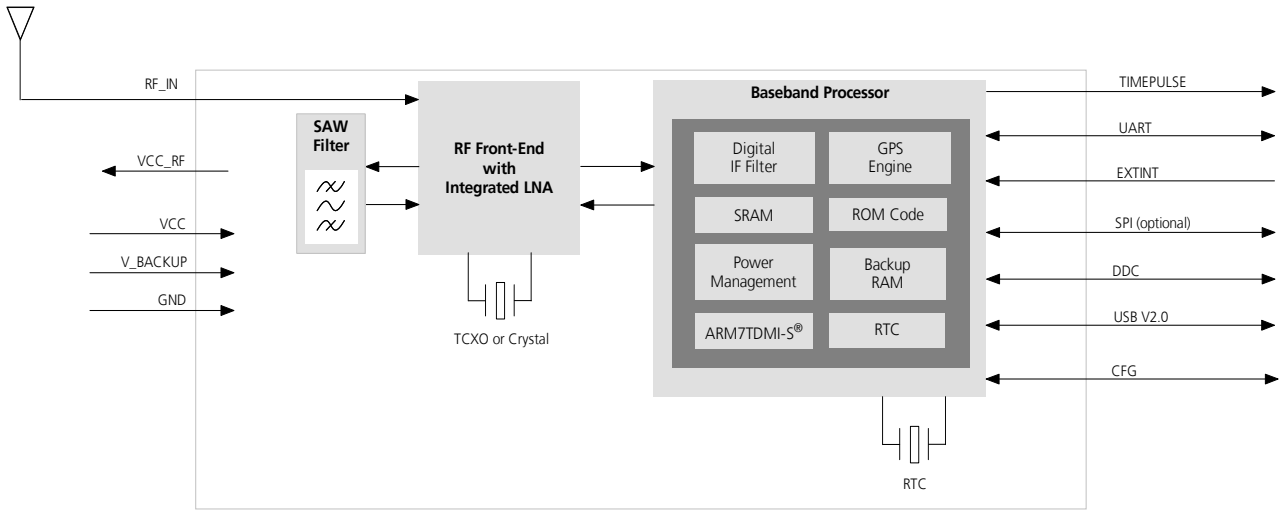

Figure 1: NEO-5 Hardware Block Schematic

[2] All satellites at -130 dB
[3] Dependent on aiding data connection speed and latency
[4] Demonstrated with a good active antenna
[5] CEP, 50%, 24 hours static, -130dBm. SEP: <3.5m
[6] Valid for ROM 5.00 based products only. For ROM 4.0 products if absolute time is required, then a calibration is necessary.
[7] 50% @ 30 m/s

1.5 Assisted 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. NEO-5 modules support the u-blox AssistNow Online and AssistNow Offline-GPS services.

1.6 SuperSense Indoor GPS

All u-blox 5 modules come with SuperSense, providing ultra-fast acquisition/reacquisition and exceptional tracking sensitivity. SuperSense enables best-in-class tracking and navigation in difficult signal environments such as urban canyons or indoor locations.

1.7 KickStart

A new feature available with u-blox 5 receiver modules is KickStart. This functionality uses a TCXO to accelerate weak signal acquisition, enabling faster start and reacquisition times. KickStart is available with the NEO-5Q.

1.8 Protocols

The NEO-5 modules support different serial protocols.

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 Protocol Specification* [2].

1.9 Antenna

NEO-5 modules are designed for use with passive and active[8] antennas.

Parameter	Specification	
Antenna Type		Active[8] and passive antennas
Active Antenna Recommendations	Minimum gain	15 - 20 dB (to compensate signal loss in RF cable)
	Maximum noise figure	1.5 dB
	Maximum gain	50 dB

Table 4: Antenna Specification

1.10 External Serial EEPROM

NEO-5 modules provide an I^2C compliant DDC interface to connect an optional external serial EEPROM to store power-up configuration settings.

☞ This feature is only supported by modules with ROM 5.0 and above. For more information see the *NEO-5 Hardware Integration Manual* [1] and the *DDC Implementation Application Note* [3].

[8] For information on using active antennas with NEO-5 modules, see the *NEO-5 Hardware Integration Manual* [1].

1.11 Configuration

1.11.1 Power Modes

u-blox 5 technology offers power optimized architecture with built-in autonomous power saving functions that minimize power consumption at any given time.

u-blox 5 can be operated in two different power modes: Maximum Performance and Eco Mode. In both cases, the receiver is operated in continuous mode. The difference lies in how the acquisition engine is used. Maximum Performance Mode freely uses the acquisition engine, resulting in the best possible TTFF at weak signals. With Eco Mode the use of the acquisition engine is optimized to deliver lower current consumption.

Low Power Modes are planned. For more information, see the *u-blox 5 Protocol Specification* [2].

1.11.2 Boot-Time Configuration

The NEO-5 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.

All NEO-5 modules include a **CFG_COM0** pin, which can be configured as seen in Table 5.

CFG_COM0	Protocol	Messages	UART Baud rate	USB Power
1	**NMEA**	**GSV, RMC, GSA, GGA, GLL, VTG, TXT**	**9600**	**BUS Powered**[9]
0			38400	Self Powered

Table 5: Supported COM settings

NEO-5G and NEO-5Q include both **CFG_COM0** and **CFG_COM1** pins and can be configured as seen in Table 5. Default settings in bold.

CFG_COM1	CFG_COM0	Protocol	Messages	UART Baud rate	USB Power
1	**1**	**NMEA**	**GSV, RMC, GSA, GGA, GLL, VTG, TXT**	**9600**	**BUS Powered**
1	0			38400	Self Powered
0	1		GSV, 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 6: Supported COM settings (NEO-5G, NEO-5Q)

The NEO-5G and NEO-5Q provide a **CFG_GPS0** pin for power mode configuration. This can be configured as seen in Table 7.

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

Table 7: Supported CFG_GPS0 settings (NEO-5G, NEO-5Q)

☞ The **CFG_GPS0** pin is shared with the SPI Clock pin. When using Eco Mode and SPI, pull **CFG_GPS0** low during startup and then release it.

[9] Bus powered mode supported with FW 5.00 and above.

2 Mechanical Specifications

Parameter	Specification	
A	16.0 +0.6/-0.1mm	[628.8 +24/-4mil]
B	12.2 ±0.1mm	[479.5 ±4mil]
C	2.4 ±0.2mm	[94.3 ±8mil]
D	1.0 +0.3/-0.1mm	[39.3 +18/-4mil]
E	1.1 ±0.1mm	[43.2 ±4mil]
F	3.0 ±0.1mm	[117.9 ±4mil]
G	1.1 ±0.1mm	[43.2 ±4mil]
Weight	1.6 g	

Table 8: NEO-5 Dimensions

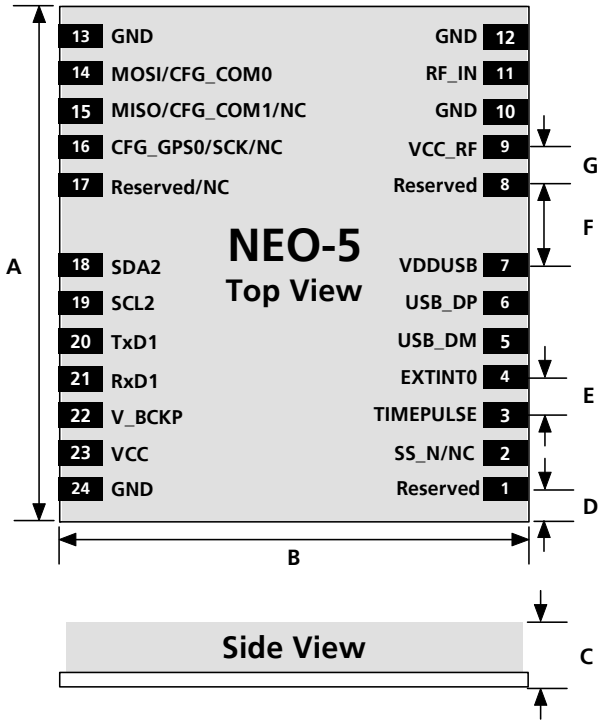

Figure 2: NEO-5 Dimensional Diagram (see Table 8 for specification)

☞ For more information regarding the Footprint and Paste Mask consult the *NEO-5 Hardware Integration Manual* [1].

2.1 Pin Assignment

No	Module	Name	I/O	Description
1	All	Reserved	I	
2	NEO-5Q/NEO-5G	SS_N	I	SPI Slave Select
	NEO-5M/NEO-5D	NC	I	Not Connected
3	All	TIMEPULSE	O	Time pulse (1PPS)
4	All	EXTINT0	I	External Interrupt Pin
5	All	USB_DM	I/O	USB Data
6	All	USB_DP	I/O	USB Data
7	All	VDDUSB	I	USB Supply
8	All	Reserved		See Hardware Integration Manual
9	All	VCC_RF	O	Output Voltage RF section
10	All	GND	I	Ground
11	All	RF_IN	I	GPS signal input
12	All	GND	I	Ground
13	All	GND	I	Ground
14	NEO-5Q/NEO-5G	MOSI/CFG_COM0	O/I	SPI MOSI / Configuration Pin
	NEO-5M/NEO-5D	CFG_COM0	I	Configuration Pin
15	NEO-5Q/NEO-5G	MISO/CFG_COM1	I	SPI MISO / Configuration Pin. Leave open if not used.
	NEO-5M/NEO-5D	NC	I	Not Connected
16	NEO-5Q/NEO-5G	CFG_GPS0 SCK	I/O	Power Mode Configuration Pin SPI Clock
	NEO-5M/NEO-5D	NC	I/O	Not Connected
17	NEO-5Q/NEO-5G	Reserved	O	
	NEO-5M/NEO-5D	NC	O	Not Connected
18	All	SDA2	I/O	DDC Data
19	All	SCL2	I/O	DDC Clock
20	All	TxD1	O	Serial Port 1
21	All	RxD1	I	Serial Port 1
22	All	V_BCKP	I	Backup voltage supply
23	All	VCC	I	Supply voltage
24	All	GND	I	Ground

Must be connected

Table 9: Pinout

Pins designated Reserved should only be used with caution. For more information about Pinouts see the *NEO-5 Hardware Integration Manual* [1].

3 Electrical Specifications

3.1 Absolute Maximum Ratings

Parameter	Symbol	Module	Min	Max	Units	Condition
Power supply voltage (VCC)	Vcc	NEO-5Q, NEO-5M	-0.5	3.6	V	
		NEO-5D, NEO-5G	-0.5	2.0	V	
Backup battery voltage (V_BCKP)	Vbckp	All	-0.5	3.6	V	
USB supply voltage (VDDUSB)	Vddusb	All	-0.5	3.8	V	
Input pin voltage	Vin	All	-0.5	Vcc +0.5	V	
	Vin_usb	All	-0.5	Vddusb +0.5	V	
VCC_RF output current	Iccrf	All		100	mA	
Input power at RF_IN	Prfin	All		+5	dBm	
Storage temperature	Tstg	All	-40	85	°C	

Table 10: Absolute Maximum Ratings

GPS receivers are Electrostatic Sensitive Devices (ESD) and require special precautions when handling. For more information see the *NEO-5 Hardware Integration Manual* [1].

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.

For Prfin: source impedance=50Ω, continuous wave.

3.2 Operating Conditions

Parameter[10]	Symbol	Module	Min	Typ	Max	Units	Condition
Power supply voltage (VCC)	Vcc	NEO-5Q, NEO-5M	2.7	3.0	3.6	V	
		NEO-5D, NEO-5G	1.75	1.8	2.0		
Peak supply current [11]	Iccp	All			150	mA	Vcc = 3.6V[12] / 2.0V[13]
Sustained supply current[14]	Icc Acquisition (Max Performance Mode)	All		102		mA	Vcc = 3.0V[12] / 1.8V[13]
	Icc Tracking (Max Performance Mode)	NEO-5D, NEO-5M		43[15]			
		NEO-5G, NEO-5Q		44[15]			
	Icc Acquisition (Eco Mode)	All		67			
	Icc Tracking (Eco Mode)	NEO-5D, NEO-5M		40[16]			
		NEO-5G, NEO-5Q		41[16]			
Backup battery voltage	Vbckp	All	1.4		3.6	V	
Backup battery current	Ibckp	All		25		µA	Vbckp = 1.8V
Input pin voltage range	Vin	All			Vcc +0.5	V	
Input pin low voltage	Vin_low_1	All			0.2x Vcc	V	
Input pin high voltage	Vin_high_1	All	0.7x Vcc			V	
Input pin low voltage for RxD1	Vin_low_2	All			0.22	V	
Input pin high voltage for RxD1	Vin_high_2	All	0.91			V	
Output pin voltage range	Vout	All				V	
Output pin low voltage	Vout_low	All			0.4	V	Iout = 4 mA
Output pin high voltage	Vout_high	All	Vcc – 0.4			V	Iout = -4 mA
VDDUSB (Pin 7) for USB operation	Vddusb1	All	3.0[17]		3.6	V	
USB_DM, USB_DP	VinU	All	Compatible with USB with 27 Ohms series resistance				
Antenna gain	Gant	All			50	dB	
Receiver Chain Noise Figure	NFtot	All		2.5		dB	
RF Input Power	Prfin	All			-5	dBm	
VCC_RF voltage	Vccrf	All		Vcc-0.1		V	
VCC_RF output current	Iccrf	All			50	mA	
Operating temperature	Topr	All	-40		85	°C	

Table 11: Operating Conditions

☞ Operation beyond the "Operating Conditions" is not recommended and extended exposure beyond the "Operating Conditions" may affect device reliability.

[10] All specification are at an ambient temperature of 25°C.
[11] Use this figure to dimension maximum current capability of power supply.
[12] NEO-5Q, NEO-5M
[13] NEO-5D, NEO-5G
[14] Use this figure to determine required battery capacity.
[15] FW 5.00, with strong signals, all orbits available. For Cold Starts typical 10 min after First Fix. For Hot Starts typical 15 sec after First Fix.
[16] FW 5.00, with strong signals. For Cold Starts typical 1 min after First Fix. For Hot Starts typical 15 sec after First Fix
[17] If USB not used connect to GND

4 Reliability Tests

Tests for product family qualifications:

Test		Standard
Visual inspection		IPC-A-610 "Acceptability of electronic assemblies" I.T.R.I. Publication No. 700 IPC-SM-840B Class 2.
Thermal shock	-40°C...+125°C, 100 cycles	IEC 68-2-14
Function at various temperatures	-40°C/2 hours; RT/2 hours; +85°C/2 hours; function tests at stable temperature	IEC 68-2-1 and IEC 68-2-2
Lifespan test	+85°C/1000 hours, in function	IEC 68-2-2
Damp heat, cyclic	+25°C...+55°C; >90% Rh	IEC 68-2-30
Vibration Shock	10-500 Hz; 2 hours/axis; 5g 30g/11ms (halfsine); 3 Shock/axis; no function	IEC 68-2-6 IEC 68-2-27
Metallographic investigations		IPC-QE-650

Table 12: Reliability Tests

☞ This specification is preliminary and subject to confirmation.

5 Design-In

In order to obtain the necessary information to conduct a proper design-in, u-blox strongly recommends consulting the *NEO-5 Hardware Integration Manual* [1].

6 Default Settings

Interface	Settings
Serial Port 1 Output	9600 Baud, 8 bits, no parity bit, 1 stop bit Configured to transmit both NMEA and UBX protocols, but only following NMEA and 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 following NMEA and no UBX messages have been activated at start-up: **GGA, GLL, GSA, GSV, RMC, VTG, TXT** USB Power Mode: Bus Powered
Serial Port 1 Input	9600 Baud, 8 bits, no parity bit, 1 stop bit, Autobauding disabled Automatically accepts following protocols without need of explicit configuration: UBX, NMEA The GPS receiver supports interleaved UBX and NMEA messages.
USB Input	Automatically accepts following protocols without need of explicit configuration: UBX, NMEA The GPS receiver supports interleaved UBX and NMEA messages. USB Power Mode: Bus Powered
TIMEPULSE (1Hz Nav)	1 pulse per second, synchronized at rising edge, pulse length 100ms
Power Mode	NEO-5Q, NEO-5G: Maximum Performance Mode NEO-5M, NEO-5D: Eco Mode

Table 13: Available Protocols.

Please refer to the *u-blox 5 Protocol Specification [2]* for information about further settings.

7 Ordering Information

Ordering No.	Product
NEO-5D-0	NEO-5D GPS Module, Tape on reel, 250 pieces per reel
NEO-5G-0	NEO-5G GPS Module, Tape on reel, 250 pieces per reel
NEO-5Q-0	NEO-5Q GPS Module, Tape on reel, 250 pieces per reel
NEO-5M-0	NEO-5M GPS Module, Tape on reel, 250 pieces per reel
EVK-5H-0	u-blox 5 Evaluation Kit with KickStart
EVK-5P-0	u-blox 5 Evaluation Kit with SuperSense®

Table 14: Ordering Information

Related Documents

[1] NEO-5 Hardware Integration Manual, Docu. No GPS.G5-MS5-08003

[2] u-blox 5 Protocol Specification, Docu. No GPS-X-07036

[3] DDC Implementation Application Note, Docu. No GPS.G5-X-08023

All these documents are available on our website (www.u-blox.com).

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

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