u-blox AG
Zürcherstrasse 68
8800 Thalwil
Switzerland
www.u-blox.com

Phone +41 44 722 7444
Fax +41 44 722 7447
info@u-blox.com

NEO-5
u-blox 5 GPS Modules

Hardware Integration Manual

Abstract

This document describes the hardware features and specifications of the u-blox 5 powered NEO-5 series of cost effective, high-performance ROM-Based 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, low power consumption and an innovative jamming-resistant RF architecture. The compact 16.0 x 12.2 mm form factor of the highly successful NEO-4S is maintained, enabling easy migration. The NEO-5 series supports passive and active antennas.

your position is our focus

Manual

Title	NEO-5	
Subtitle	Hardware Integration Manual	
Doc Type	Manual	Preliminary
Doc Id	GPS.G5-MS5-08003-B1	

Revision Index	Date	Name	Status / Comments
Initial Version	29/10/2008	TG	
A1	28/04/2008	TG	Addition of Hardware Description, Product Handling, Product Testing, Appendix, Power Modes, USB
A2	7/05/2008	TG	Update of pin tables
B	5/11/2008	TG	Module Selector, Power Modes, USB Power, ESD, Migration Table, Design-in table, Paste Mask, Antenna Information
B1	12/12/2008	TG	DDC, Design in recommendations

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.

Preface

u-blox Technical Documentation

As part of our commitment to customer support, u-blox maintains an extensive volume of technical documentation for our products. In addition to our product-specific technical data sheets, the following manuals are available to assist u-blox customers in product design and development.

- **GPS Compendium:** This document, also known as the GPS book, provides a wealth of information regarding generic GPS questions about system functionalities and technology.
- **Protocol Specification:** Messages, configuration and functionalities of the u-blox 5 software releases are explained in this document.
- **Hardware Integration Manual:** This Manual provides hardware design instructions and information on how to set up production and final product tests.
- **Application Note:** document provides general design instructions and information that applies to all u-blox GPS receivers. See Section **Related Documents** for a list of Application Notes related to your GPS receiver.

How to use this Manual

The NEO-5 Hardware Integration Manual provides the necessary information to successfully design in and configure these u-blox 5 powered GPS receiver modules. For navigating this document please note the following:

This manual has a modular structure. It is not necessary to read it from the beginning to the end. To help in finding needed information, a brief section overview is provided below:

1. **Hardware Description**: This chapter introduces the basics of function and architecture of the NEO 5 modules.
2. **Design-In**: This chapter provides the Design-In information necessary for a successful design.
3. **Product Handling**: This chapter defines packaging, handling, shipment, storage and soldering.
4. **Product Testing**: This chapter provides information about testing of OEM receivers in production.
5. **Appendix**: The Appendix includes guidelines on how to successfully migrate to u-blox 5 designs.

The following symbols are used to highlight important information within the manual:

☞ An index finger points out key information pertaining to module integration and performance.

⚠ **A warning symbol indicates actions that could negatively impact or damage the module.**

Questions

If you have any questions about u-blox 5 Hardware Integration, please:

- Read this manual carefully.
- Contact our information service on the homepage http://www.u-blox.com
- Read the questions and answers on our FAQ database on the homepage http://www.u-blox.com

Technical Support

Worldwide Web

Our website (www.u-blox.com) is a rich pool of information. Product information, technical documents and helpful FAQ can be accessed 24h a day.

By E-mail

If you have technical problems or cannot find the required information in the provided documents, contact the nearest of the Technical Support offices by email. Use our service pool email addresses rather than any personal email address of our staff. This makes sure that your request is processed as soon as possible. You will find the contact details at the end of the document.

Helpful Information when Contacting Technical Support

When contacting Technical Support please have the following information ready:

- Receiver type (e.g. NEO-5M) and firmware version (e.g. V4.00)
- Receiver configuration
- Clear description of your question or the problem together with a u-center logfile
- A short description of the application
- Your complete contact details

Contents

1 Hardware Description

1.1 Functional Overview

The NEO-5 module series is a family of self-contained GPS receivers featuring the high performance 50-channel u-blox 5 positioning engine. These modules provide exceptional GPS performance in a compact form factor and at an economical price. u-blox 5 sets a new standard in GPS receiver technology. 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. Once acquired, satellites are passed on to a 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 provide a high level of immunity to jamming, ensuring maximum GPS performance. u-blox 5 has been designed to be able to support the GALILEO system currently being developed by European authorities. The capability of receiving GALILEO L1 signals will provide increased coverage and even better positioning accuracy when this system comes into operation.

With the NEO-5 series the complete signal processing chain from antenna input to serial output is contained within a single component. NEO-5 modules maintain the compact 16.0 x 12.2 mm form factor of the highly successful NEO-4S predecessor. The NEO-5 modules have been designed with backwards compatibility in mind, enabling ease of upgrade and reducing engineering and design costs.

Their small size makes NEO-5 modules the ideal GPS solution for applications with stringent space requirements. The packaging makes expensive RF cabling obsolete, with the RF input being available directly on a pin. The NEO-5 series are SMT solderable and can be handled by standard pick and place equipment.

NEO-5 modules come equipped with a serial port, which can handle NMEA and UBX proprietary data formats, as well as a high speed USB port.

All NEO-5 modules are RoHS compliant (lead-free) and green (no halogens).

The NEO-5 series of GPS/GALILEO receiver 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.

1.2 Module Selector

u-blox provides several modules using the popular NEO Form factor. To select the right product for your design consider Table 1.

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

P= Planned

Table 1: Features of the NEO-5 Series

1.3 Architecture

NEO-5 modules are divided into two functional sections. The smaller section is the RF- Section, the larger section contains the Baseband. See Figure 1 for a block diagram of the NEO-5 series.

The RF Front-End contains the integrated Low Noise Amplifier (LNA), the SAW bandpass filter, the u-blox 5 RF-IC and the TCXO or XTO crystal.

The Baseband section contains the digital circuitry comprised of the u-blox 5 Baseband processor and the RTC crystal.

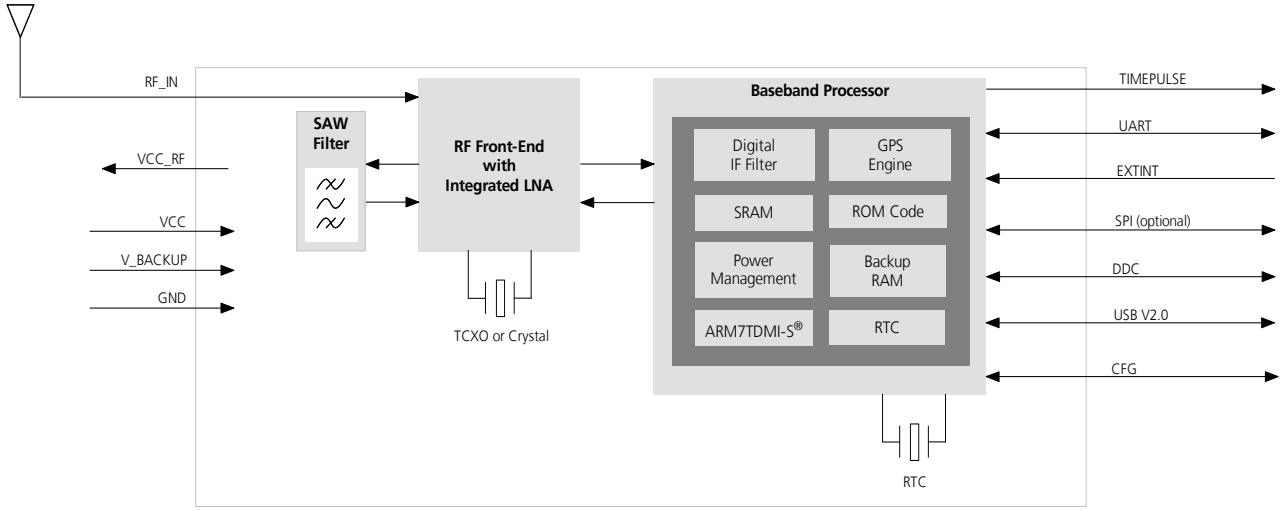


Figure 1: NEO-5 Block Diagram

2 Design-In

☞ For migrating existing ANTARIS®4 product designs to u-blox 5 please refer to *Appendix A*.

In order to obtain good performance with a GPS receiver module, there are a number of points that require careful attention during the design-in. These include:

- Power Supply
  Good performance requires a clean and stable power supply.
- Interfaces
  Ensure correct wiring, rate and message setup on the module and your host system.
- Antenna interface
  For optimal performance seek short routing, matched impedance and no stubs.

2.1 Power Management

2.1.1 Connecting Power

u-blox 5 receivers have three power supply pins: **VCC**, **V_BCKP** and **VDDUSB**.

2.1.1.1 VCC - Main Power

The main power supply is fed through the **VCC** pin. During operation, the current drawn by the u-blox 5 GPS module can vary by some orders of magnitude, especially, if low-power operation modes are enabled. It is important that the system power supply circuitry is able to support the peak power (see datasheet for specification) for a short time. In order to define a battery capacity for specific applications the sustained power figure shall be used.

2.1.1.2 V_BCKP - Backup Battery

In case of a power failure on pin **VCC**, the real-time clock and backup RAM are supplied through pin **V_BCKP**. This enables the u-blox 5 receiver to recover from a power failure with either a Hotstart or a Warmstart (depending on the duration of **VCC** outage) and to maintain the configuration settings. If no backup battery is connected, the receiver performs a Coldstart at power up.

☞ If no backup battery available connect the **V_BCKP** pin to **GND (or VCC)**.

As long as **VCC** is supplied to the u-blox 5 receiver, the backup battery is disconnected from the RTC and the backup RAM in order to avoid unnecessary battery drain (see Figure 2). Power to RTC and BBR is supplied from **VCC** in this case.

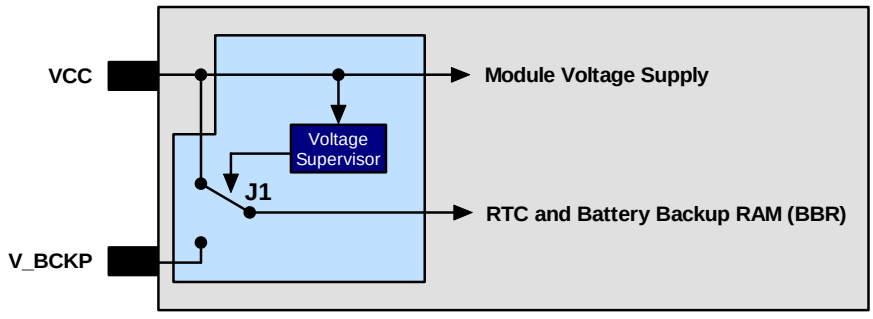


Figure 2: Backup Battery and Voltage

2.1.1.3 VDD_USB - USB Interface Power Supply

VDD_USB supplies the I/Os of the USB interface. If the USB interface is not used, the **VDD_USB** pin must be connected to GND. For more information regarding the correct handling of VDD_USB see section 2.3.2

2.1.2 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* [3].

2.1.3 Active Antenna Supply

With NEO-5 modules active antennas are supplied via an external coil or circuit. See Section 2.5.2 for more information.

2.2 System Functions

2.2.1 EXTINT - External Interrupt Pin

EXTINT0 is an external interrupt pin. It will be used in future NEO-5 releases for wake-up functions in low-power modes.

2.2.2 System Monitoring

The u-blox 5 GPS and GALILEO Receiver provides System Monitoring functions that allow the operation of the embedded processor and associated peripherals to be supervised. These System Monitoring functions are being output as part of the UBX protocol, class 'MON'.

Please refer to the *u-blox 5 Protocol Specification* [3]. For more information on UBX messages, serial interfaces for design analysis and individual system monitoring functions.

2.3 Interfaces

2.3.1 Serial

UART 1 (**RxD1/TxD1**) is the default serial interface. It supports data rates from 4.8 kBit/s to 115 kBit/s. The signal levels are CMOS 0 V to VCC. An interface based on RS232 standard levels (+/- 12 V) can be realized using level shifters such as Maxim MAX3232.

☞ The **RxD1** has fixed input voltage thresholds, which do not depend on **VCC** (see *NEO-5 Data Sheet* [2]). Leave open if unused.

For the default settings see the *NEO-5 Data Sheet* [2].

Hardware handshake signals and synchronous operation are not supported.

2.3.2 USB

The u-blox 5 USB interface supports the full-speed data rate of 12 Mbit/s. The USB interface requires some external components in order to implement the physical characteristics required by the USB 2.0 specification. These external components are shown in Figure 3 and listed in Table 2.

In order to comply with USB specifications, VBUS must be connected through an LDO (U1) to pin **VDD_USB** of the module.

If the USB device is **self-powered** it is possible that the power supply (VCC) is shut down and the Baseband-IC core is not powered. Since VBUS is still available, it still would be signaled to the USB host that the device is present and ready to communicate. This is not desired and thus the LDO (U1) should be disabled using the enable signal (EN) of the VCC-LDO or the output of a voltage supervisor. Depending on the characteristics of the LDO (U1) it is recommended to add a pull-down resistor (R11) at its output to ensure **VDD_USB** is not floating if LDO (U1) is disabled or the USB cable is not connected i.e. VBUS is not supplied. If the device is **bus-powered**, LDO (U1) does not need an enable control.

All u-blox 5 receivers based on ROM 5.00 and above support both Bus and Self Powered Mode on the USB interface. Please be sure to use the latest drivers from our website.

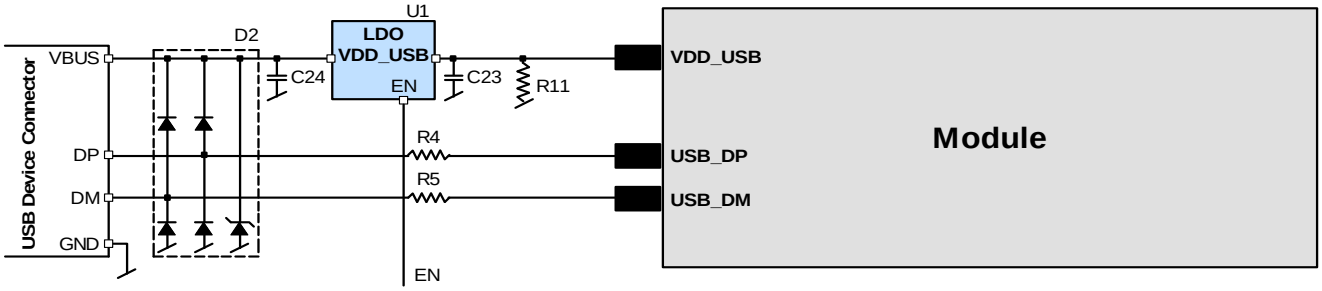


Figure 3: USB Interface

Name	Component	Function	Comments
U1	LDO	Regulates VBUS (4.4 …5.25 V) down to a voltage of 3.3 V).	Almost no current requirement (~1 mA) if the GPS receiver is operated as a USB self-powered device, but if bus-powered LDO (U1) must be able to deliver the maximum current of ~150 mA. A low-cost DC/DC converter such as LTC3410 from Linear Technology may be used as an alternative if power consumption is critical.
C23, C24	Capacitors		Required according to the specification of LDO U1
D2	Protection diodes	Protect circuit from overvoltage / ESD when connecting.	Use low capacitance ESD protection such as ST Microelectronics USBLC6-2.
R4, R5	Serial termination resistors	Establish a full-speed driver impedance of 28…44 Ohms	A value of 27 Ohms is recommended.
R11	Resistor	Ensures stable signal at **VDD_USB.**	10k R is recommended for USB self-powered setup. For bus-powered setup R11 can be ignored.

Table 2: Summary of USB external components

2.3.3 Display Data Channel (DDC)

An I2C compatible DDC interface is available for serial communication. For more information see the *DDC Implementation Application Note* [4].

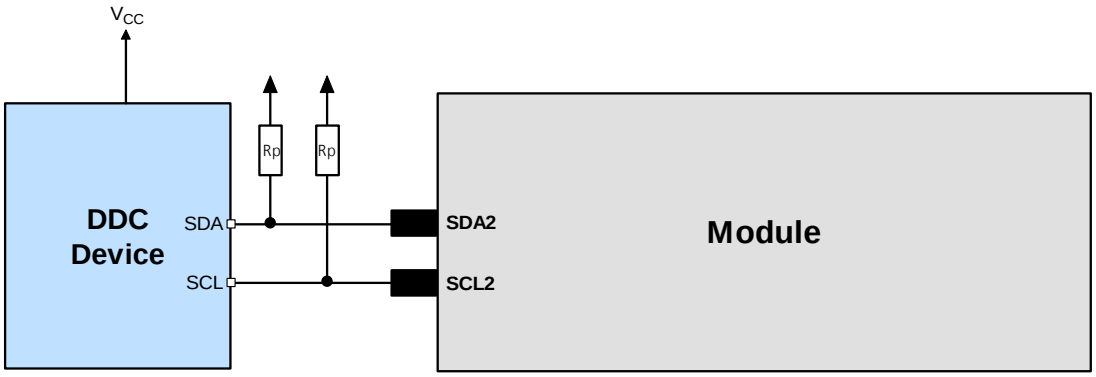


Figure 4: Typical DDC Connection

2.3.4 Synchronous Peripheral Interface (SPI)

An SPI interface is available for serial communication. For more information see the *SPI Implementation Application Note* [5].

☞ No Master Mode: External memory is not supported at this time.

2.4 I/O Pins

2.4.1 EXTINT0

EXTINT0 is an external interrupt pin with fixed input voltage thresholds independent of VCC (see the *NEO-5 Data Sheet* [2]). Leave open if unused.

2.4.2 Configuration Pins (CFG_COM0, CFG_COM1, CFG_GPS0)

NEO-5 modules provide one or three pins for boot-time configuration. These pins 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.

Some configuration pins are shared with other functions, e.g. SPI. During start-up, the module reads the state of the configuration pins. Afterwards the other functions can be used.

For more information about settings and messages see the *NEO-5 Data Sheet* [2].

2.5 Design-In

This section provides a Design-In Checklist as well as Reference Schematics for new designs with u-blox 5. For migration of existing ANTARIS®4 product designs to u-blox 5 please refer to *Appendix A*.

Good performance requires a clean and stable power supply with minimal ripple. Care needs to be exercised in selecting a strategy to achieve this. Series resistance in the Vcc supply line can negatively impact performance. For better performance, use an LDO to provide a clean supply at Vcc and consider the following:

- Wide power lines or even power planes are preferred.
- Place LDO near the module.
- Avoid resistive components in the power line (e.g. narrow power lines, coils, resistors, etc.).

Placing a filter or other source of resistance at Vcc can create significantly longer acquisition times.

2.5.1 Schematic Design-In Checklist for u-blox 5

Designing-in a NEO-5 GPS receiver is easy especially when a design is based on the reference design in the Hardware Integration Manual. Nonetheless, it pays to do a quick sanity check of the design. This section lists the most important items for a simple design check. The Layout Design-In Checklist also helps to avoid an unnecessary respin of the PCB and helps to achieve the best possible performance.

☞ It is highly recommended to follow the Design-In Checklist when developing any u-blox 5 GPS applications. This can significantly reduce development time and costs.

Have you chosen the optimal module?

NEO-5 modules have been intentionally designed to allow GPS receivers to be optimally tailored to specific applications. Changing between the different variants is easy.

- ❑ Do you need Kick-start performance – Then choose NEO-5**Q** or NEO-5**G**.

Check Power Supply Requirements and Schematic:

- ❑ Is the power supply within the specified range?
  3.0V: NEO-5**Q**/NEO-5**M**
  1.8V: NEO-5**D**/NEO-5**G**
- ❑ Is the voltage **VDDUSB** within the specified range?
- ❑ Compare the peak current consumption of NEO-5 with the specification of your power supply.
- ❑ GPS receivers require a stable power supply, avoid ripple on **VCC** (<50mVpp)

Backup Battery

- ❑ For achieving a minimal Time To First Fix (TTFF) after a power down, make sure to connect a backup battery to **V_BCKP.**

Antenna

- ❑ The total noise figure should be well below 3dB.
- ❑ If a patch antenna is the preferred antenna, choose a patch of at least 15x15mm. For smaller antennas an LNA with a noise figure <2dB is recommended, this can increase sensitivity up to 2dB. To optimize TTFF make use of u-blox' free aiding services AssistNow Online and AssistNow Offline.
- ❑ Make sure the antenna is not placed close to noisy parts of the circuitry. (e.g. micro-controller, display, etc.)
- ❑ To optimize performance in environments with out-band jamming sources, use an additional SAW filter.

☞ For more information dealing with interference issues see the *GPS Antenna Application Note* [6].

Schematic

- Plan use of 2nd interface (Testpoints on serial port, DDC or USB) for firmware updates or as a service connector.

2.5.2 NEO-5 Design

For a minimal Design with NEO-5 the following functions and pins need to be considered:

- Connect the Power supply to **VCC.**
- **VDDUSB:** Connect the USB power supply to a LDO before feeding it to **VDDUSB** and **VCC** or connect to GND if USB is not used.
- Ensure an optimal ground connection to all ground pins of the NEO module
- Choose the required serial communication interface (USART USB, SPI or DDC) and connect the appropriate pins to your application
- If you need Hot- or Warmstart in your application, connect a Backup Battery to **V_BCKP**
- Decide whether **TIMEPULSE** options are required in your application and connect the appropriate pins on your module
- Connect pins 8 and 9 together.
- NEO-5 modules do not provide the antenna bias voltage for active antennas on the **RF_IN** pin. It is therefore necessary to provide this voltage outside the module via an inductor as indicated in Figure 5. u-blox recommends using an inductor from Murata (LQG15HS27NJ02). Alternative parts can be used if the inductor's resonant frequency matches the GPS frequency of 1575.4MHz.

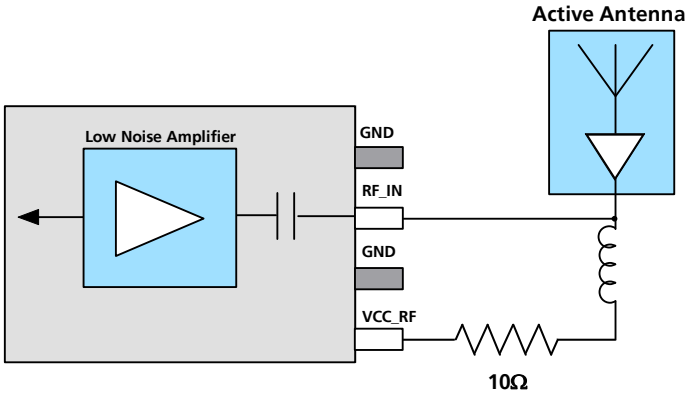


Figure 5: Recommended wiring for active antennas

- Be aware of the maximum rating for VCC_RF max current. Use a resistor or another circuit to limit current on a short (see Figure 5). This is recommended if an external active antenna is used.
- For optimal performance, it is important to place the inductor as close to the microstrip as possible. Figure 6 illustrates the recommended layout and how it should not be done.

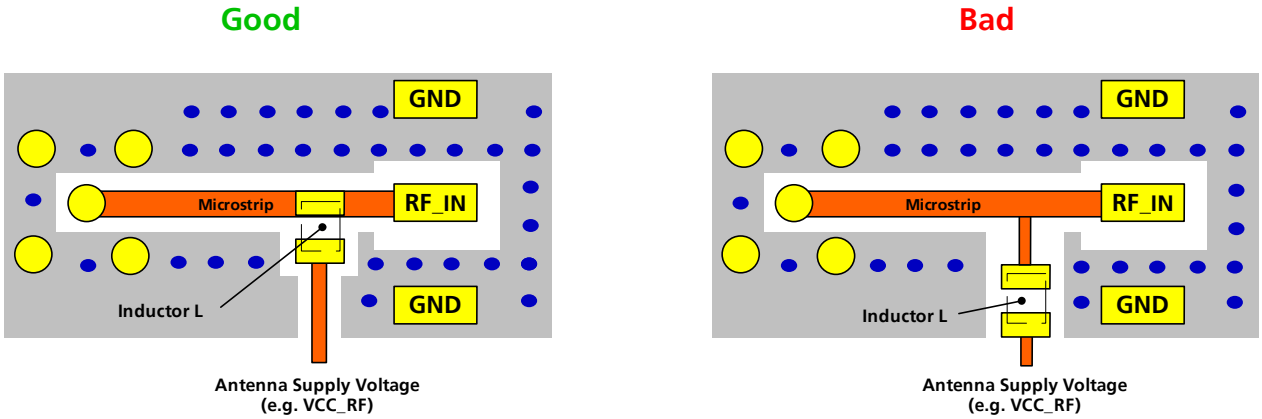


Figure 6: Recommended layout for connecting the antenna bias voltage for NEO-5

2.5.3 Design for NEO-5

This is a minimal setup for a PVT GPS receiver with a NEO-5 module.

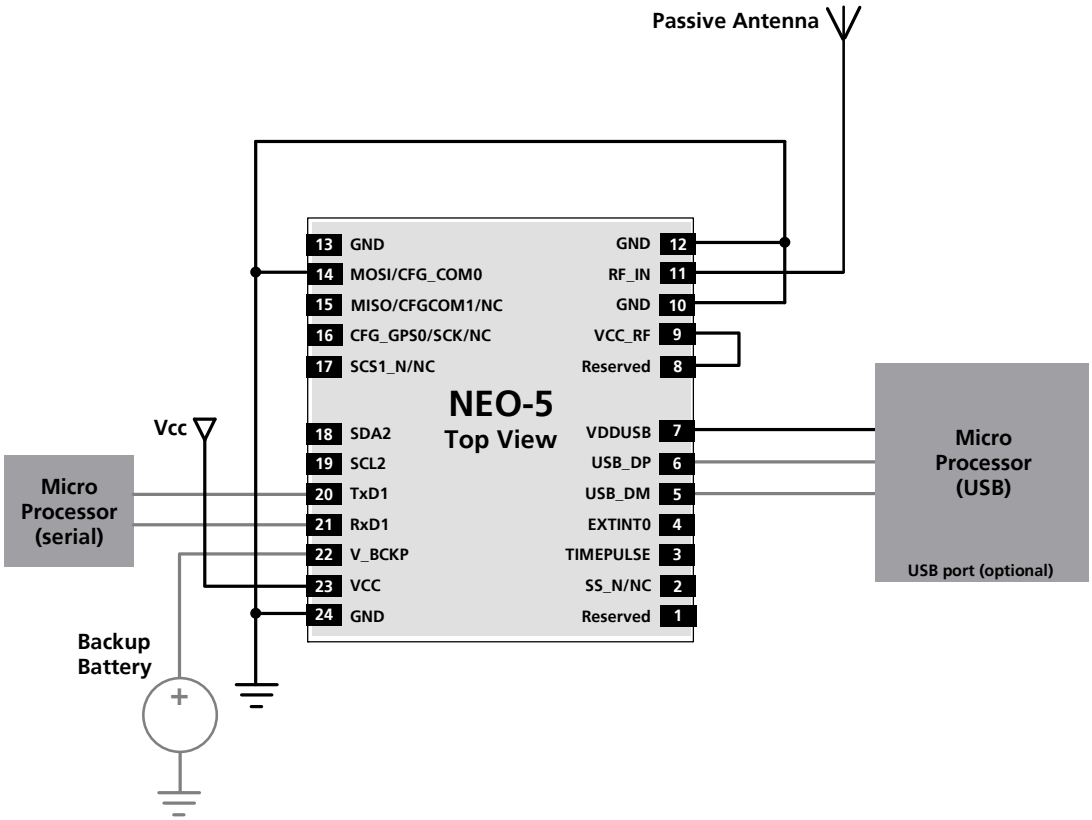


Figure 7: Passive Antenna Design for NEO-5 Receivers

The above design is for the USB in BUS-powered mode. For Self-powered mode pin 14 (CFG_COM0) must be connected to GND. In this case the NMEA baud rate on UART1 of 38400. For more information see the *NEO-5 Data Sheet* [2].

For passive antenna designs use an LNA to increase sensitivity up to 2dB.

Standard Function				Remarks
No	Name	I/O	Description	
1	Reserved	I	Reserved	Leave open
2	NC/SS_N	I	Not Connected/ SPI Slave Select	NEO-5Q/5G: Slave select input for SPI. Leave open if not used.
3	TIMEPULSE	O	Time pulse (1PPS)	Configurable Timepulse signal (one pulse per second by default). Leave open if not used.
4	EXTINT0	I	External Interrupt Pin	Leave open if not used.
5	USB_DM	I/O	USB Data	USB bidirectional communication pin. Implementation see Section 2.3.2.
6	USB_DP	I/O	USB Data	
7	VDDUSB	I	USB Supply	To use the USB interface connect this pin to 3.0 – 3.6V. If no USB serial port used connect to GND.
8	Reserved	I	Reserved	Pins 8 and 9 **must** be connected. VCC_RF can also be used to power an external active antenna.
9	VCC_RF	O	Output Voltage RF section	
10	GND	I	Ground	Assure a good GND connection to all GND pins of the module, preferably with a large ground plane.
11	RF_IN	I	GPS signal input	The connection to the antenna has to be routed on the PCB. Use a controlled impedance of 50 Ohm to connect RF_IN to the antenna or the antenna connector.
12	GND	I	Ground	See pin 10.
13	GND	I	Ground	See pin 10.
14	MOSI/CFG_COM0	O	SPI MOSI/CFG_COM0	NEO-5Q/5G[1]: Leave open if not used. CFG_COM1 is shared with SPI MOSI pin. When using CFG & SPI port, apply configuration settings needed during setup. **Note** Connect to GND to use USB in Self Powered mode. See Section 2.4.2 and the NEO-5 Data Sheet [2] NEO-5M/5D[1]: Leave open if not used.
15	MISO/CFG_COM1/ NC	I	SPI MISO/CFG_COM1 Not Connected	NEO-5Q/5G[1]: CFG_COM1 is shared with SPI MISO pin. When using CFG & SPI port, apply configuration settings needed during setup. NEO-5M/5D[1]: Leave open.
16	SCK/CFG_GPS0/ NC	I/O	SPI Clock/Power Mode Configuration/ Not Connected	NEO-5Q/5G[1]: CFG_GPS0 pin shared with the SPI Clock pin. When using Eco Mode and SPI, pull CFG_GPS0 low during startup and then release it. NEO-5M/5D[1]: Leave open.
17	SCS1_N/ NC	O	SPI chip select/ Not Connected	NEO-5Q/5G: Leave open if not used. NEO-5M/5D: not connected, leave open.
18	SDA2	I/O	DDC Data	
19	SCL2	I/O	DDC Clock	
20	TxD1	O	Serial Port 1	
21	RxD1	I	Serial Port 1	3.6V tolerant serial input. Internal pull-up resistor to VCC. Leave open if not used. Don't use an external pull up resistor.
22	V_BCKP	I	Backup voltage supply	It's recommended to connect a backup battery to V_BCKP in order to enable Warm and Hot Start features on the receiver. Otherwise connect to GND.
23	VCC	I	Supply voltage	Max allowed ripple on VCC=50mVpp
24	GND	I	Ground	See pin 10.

Table 3: Pinout NEO-5

[1] Internal pull-up to define default CFG_xxx configuration during startup. Leave open if default setting is ok and pin not otherwise used. For other configurations apply the required pin settings during startup.

2.6 Layout Design-In Checklist

Follow this checklist for the Layout design to get an optimal GPS performance.

Layout optimizations (*Section 2.7*)

- Is the GPS module placed according to the recommendation in *Section 2.7.2*?
- Has the Grounding concept been followed (see *Section 2.7.3*)?
- Has the micro strip been kept as short as possible?
- Add a ground plane underneath the GPS module to reduce interference.
- For improved shielding, add as many vias as possible around the micro strip, around the serial communication lines, underneath the GPS module etc.
- Have ESD protection measures been included (see *Section 2.9*)?

Calculation of the micro strip (*Section 2.7.5*)

- The micro strip must be 50 Ohms and be routed in a section of the PCB where minimal interference from noise sources can be expected.
- In case of a multi-layer PCB, use the thickness of the dielectric between the signal and the 1st **GND** layer (typically the 2nd layer) for the micro strip calculation.
- If the distance between the micro strip and the adjacent **GND** area (on the same layer) does not exceed 5 times the track width of the micro strip, use the "Coplanar Waveguide" model in AppCad to calculate the micro strip and not the "micro strip" model.

2.7 Layout

This section provides important information for designing a reliable and sensitive GPS/GALILEO system.

GPS signals at the surface of the Earth are about 15dB below the thermal noise floor. Signal loss at the antenna and the RF connection must be minimized as much as possible. When defining a GPS receiver layout, the placement of the antenna with respect to the receiver, as well as grounding, shielding and jamming from other digital devices are crucial issues and need to be considered very carefully.

2.7.1 Footprint

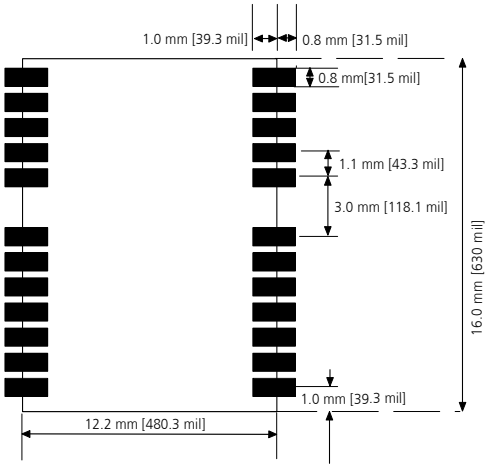


Figure 8: Recommended footprint

2.7.2 Paste Mask

Figure 9 shows the recommended positioning of the Paste Mask, the Copper and Solder masks. These are recommendations only and not specifications. Note that the Copper and Solder masks have the same size and position.

To improve the wetting of the half vias, reduce the amount of solder paste under the module and increase the volume outside of the module by defining the dimensions of the paste mask to form a T-shape (or equivalent) extending beyond the Copper mask as shown in Figure 9. The solder paste should have a total thickness of 175 to 200 µm.

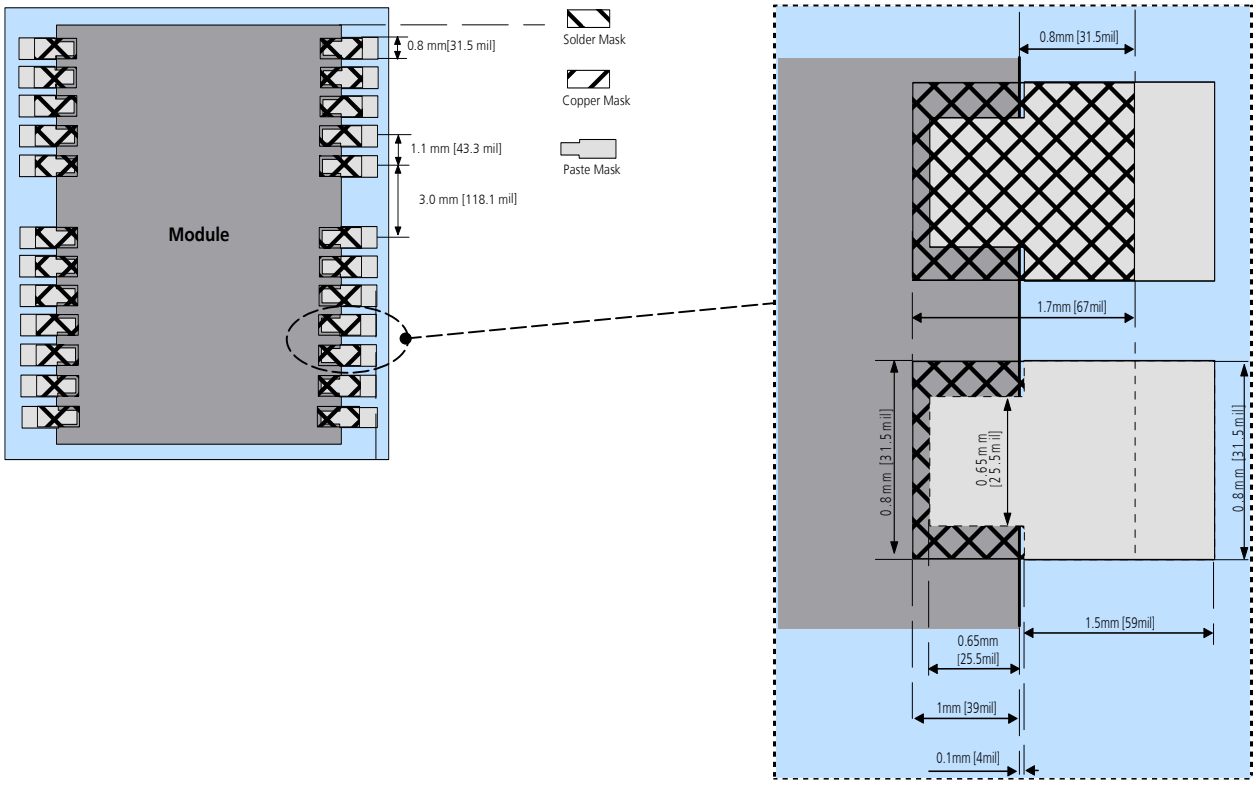


Figure 9: Recommendations for copper, solder and paste masks with enlargement

☞ The paste mask outline needs to be considered when defining the minimal distance to the next component.

☞ These are recommendations only and not specifications. The exact geometry, distances, stencil thicknesses and solder paste volumes must be adapted to the specific production processes (e.g. soldering etc.) of the customer.

2.7.3 Placement

A very important factor in achieving maximum GPS and GALILEO performance is the placement of the receiver on the PCB. The connection to the antenna must be as short as possible to avoid jamming into the very sensitive RF section.

Make sure that RF critical circuits are clearly separated from any other digital circuits on the system board. To achieve this, position the receiver digital part towards your digital section of the system PCB. Care must also be exercised with placing the receiver in proximity to circuitry that can emit heat. The RF part of the receiver is very sensitive to temperature and sudden changes can have an adverse impact on performance.

⚠ **The RF part of the receiver is a temperature sensitive component. Avoid high temperature drift and air vents near the receiver.**

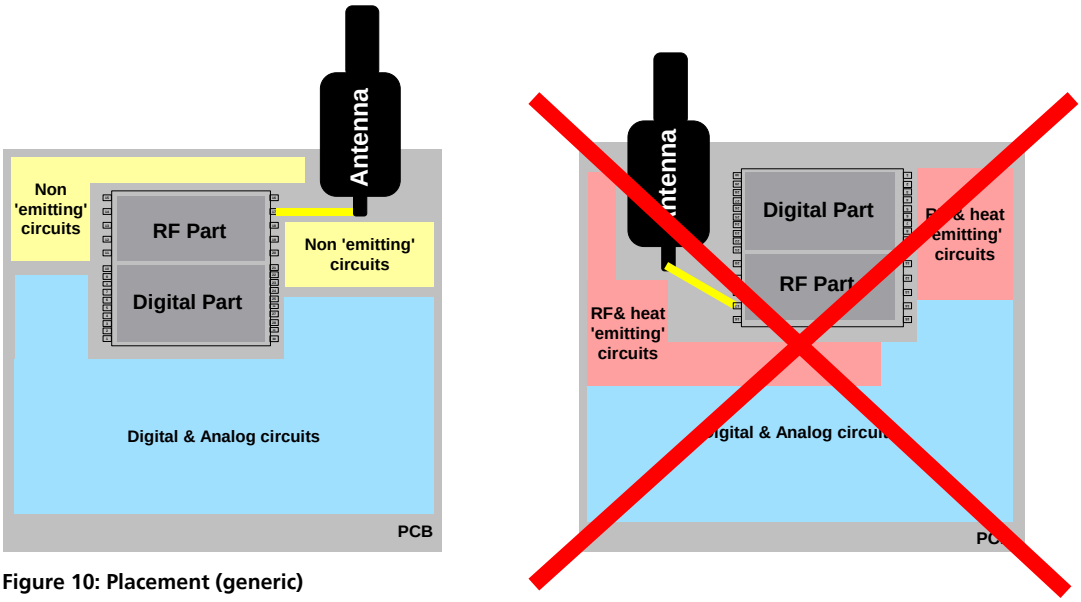


Figure 10: Placement (generic)

2.7.4 Antenna Connection and Grounding Plane Design

u-blox 5 modules can be connected to passive patch or active antennas. The RF connection is on the PCB and connects the **RF_IN** pin with the antenna feed point or the signal pin of the connector, respectively. *Figure 11* illustrates connection to a typical five-pin RF connector. One can see the improved shielding for digital lines as discussed in the *GPS Antenna Application Note* [6]. Depending on the actual size of the ground area, additional vias should be placed in the outer region. In particular, the edges of the ground area should be terminated with a dense line of vias.

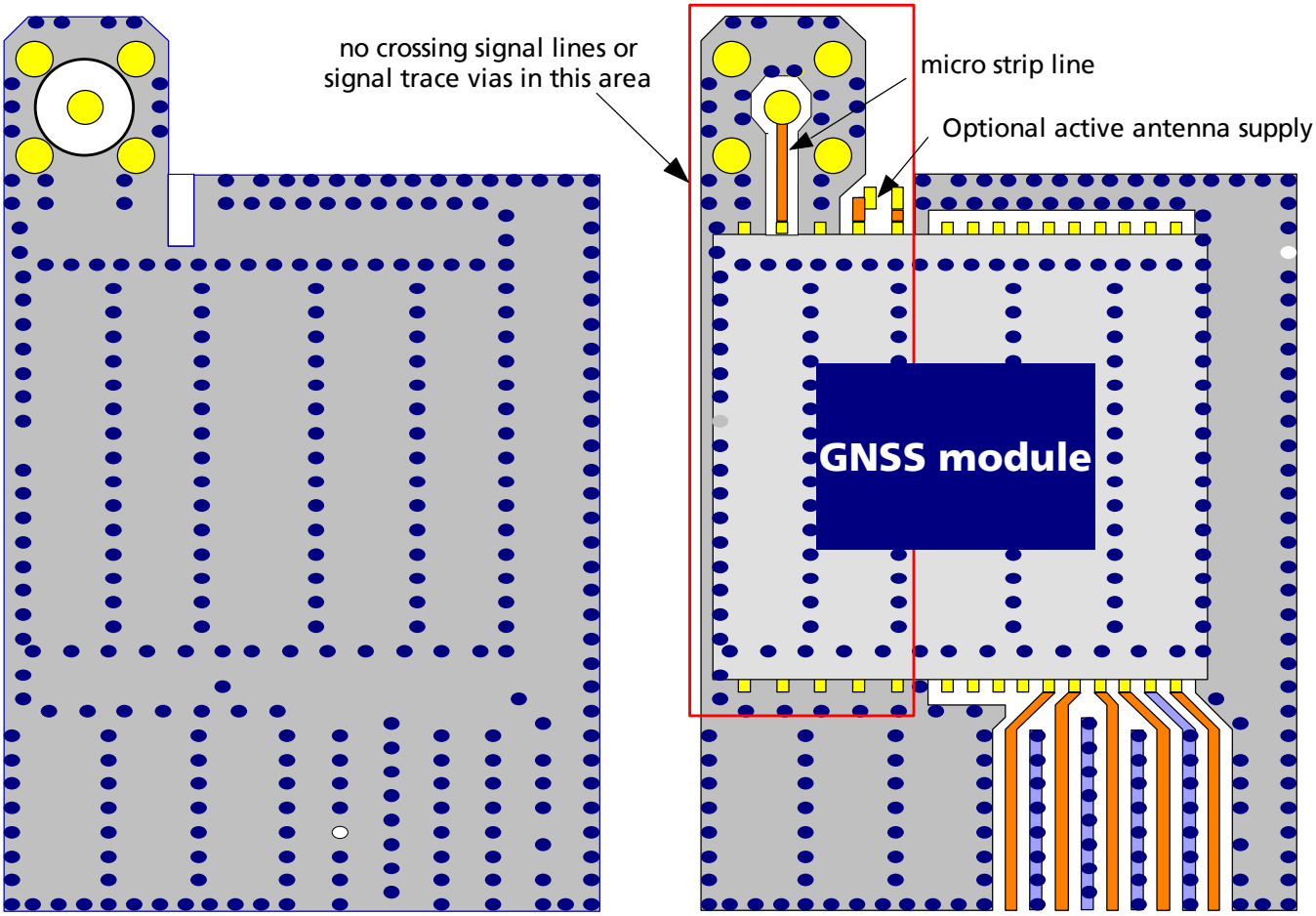


Figure 11: Recommended layout (generic)

As seen in *Figure 11,* an isolated ground area is created around and below the RF connection. This part of the circuit MUST be kept as far from potential noise sources as possible. Make certain that no signal lines cross, and that no signal trace vias appear at the PCB surface within the area of the red rectangle. The ground plane should also be free of digital supply return currents in this area. On a multi layer board, the whole layer stack below the RF connection should be kept free of digital lines. This is because even solid ground planes provide only limited isolation.

The impedance of the antenna connection has to match the 50 Ohm impedance of the receiver. To achieve an impedance of 50 Ohms, the width W of the micro strip has to be chosen depending on the dielectric thickness H, the dielectric constant ε_r of the dielectric material of the PCB and on the build-up of the PCB (see *Section 2.7.5*). *Figure 12* shows two different builds: A 2 Layer PCB and a 4 Layer PCB. The reference ground plane is in both designs on layer 2 (red). Therefore the effective thickness of the dielectric is different.

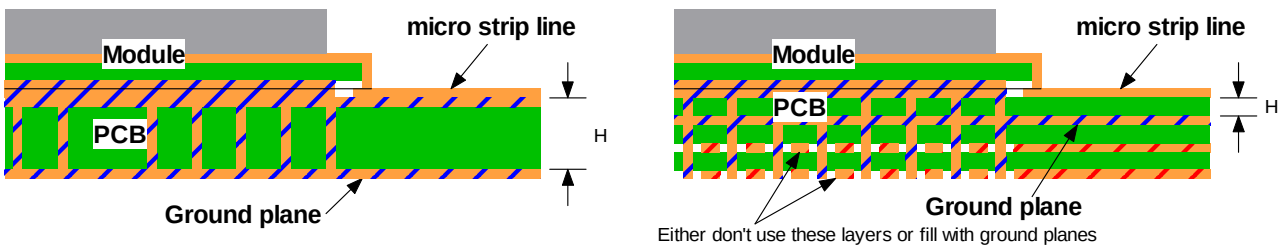
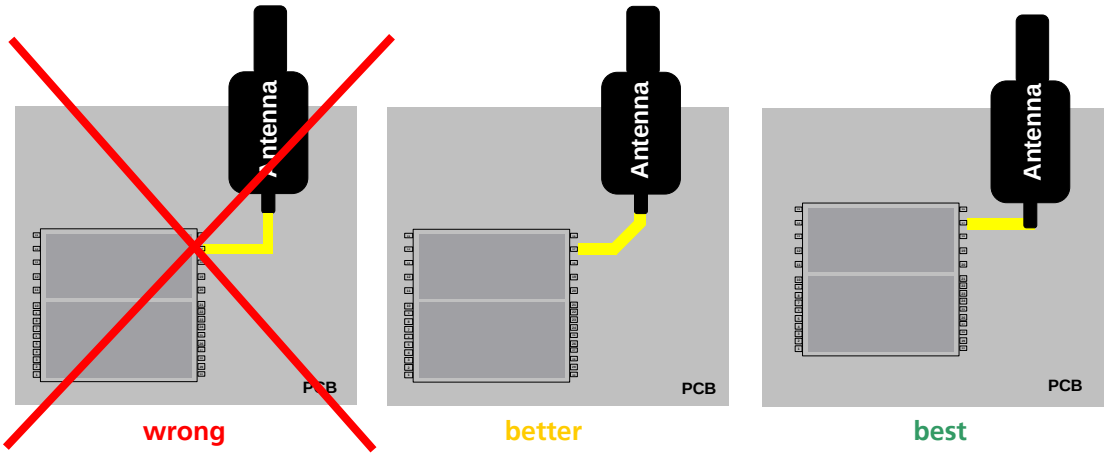


Figure 12: PCB build-up for Micro strip line. Left: 2-layer PCB, right: 4-layer PCB

General design recommendations:

- The length of the micro strip line should be kept as short as possible. Lengths over 2.5 cm (1 inch) should be avoided on standard PCB material and without additional shielding.
- Distance between micro strip line and ground area on the top layer should at least be as large as the dielectric thickness.
- Routing the RF connection close to digital sections of the design should be avoided.
- To reduce signal reflections, sharp angles in the routing of the micro strip line should be avoided. Chamfers or fillets are preferred for rectangular routing; 45-degree routing is preferred over Manhattan style 90-degree routing.



- Routing of the RF-connection underneath the receiver should be avoided. The distance of the micro strip line to the ground plane on the bottom side of the receiver is very small (some 100 µm) and has huge tolerances (up to 100%). Therefore, the impedance of this part of the trace cannot be controlled.
- Use as many vias as possible to connect the ground planes.
- In order to avoid reliability hazards, the area on the PCB under the receiver should be entirely covered with solder mask. Vias should not be open.

2.7.5 Antenna Micro Strip

There are many ways to design wave-guides on printed circuit boards. Common to all is that calculation of the electrical parameters is not straightforward. Freeware tools like AppCAD from Agilent or TXLine from Applied Wave Research, Inc. are of great help. They can be downloaded from *www.agilent.com* and *www.mwoffice.com*.

The micro strip is the most common configuration for printed circuit boards. The basic configuration is shown in *Figure 13* and *Figure 14*. As a rule of thumb, for a FR-4 material the width of the conductor is roughly double the thickness of the dielectric to achieve 50 Ohms line impedance.

For the correct calculation of the micro strip impedance, one does not only need to consider the distance between the top and the first inner layer but also the distance between the micro strip and the adjacent GND plane on the same layer

☞ Use the Coplanar Waveguide model for the calculation of the micro strip.

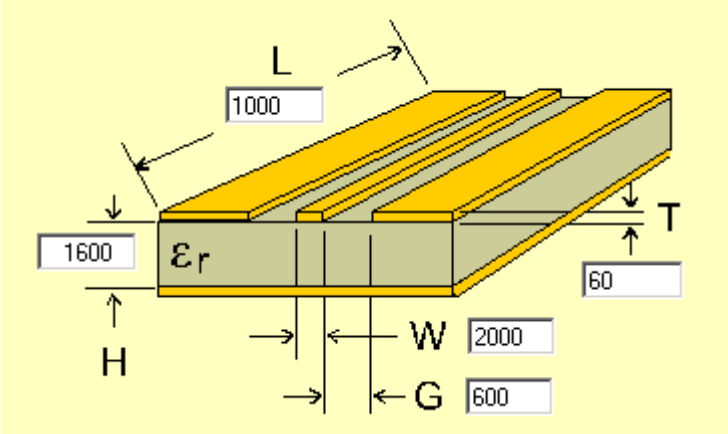


Figure 13: Micro strip on a 2-layer board (Agilent AppCAD Coplanar Waveguide)

Figure 13 shows an example of a 2-layer FR4 board of 1.6 mm thickness and a 35µm (1 once) copper cladding. The thickness of the micro strip is comprised of the cladding (35µm) plus the plated copper (typically 25µm). *Figure 14* depicts an example of a multi layer FR4 board with 18µm (½ once) cladding and 180µ dielectric between layer 1 and 2.

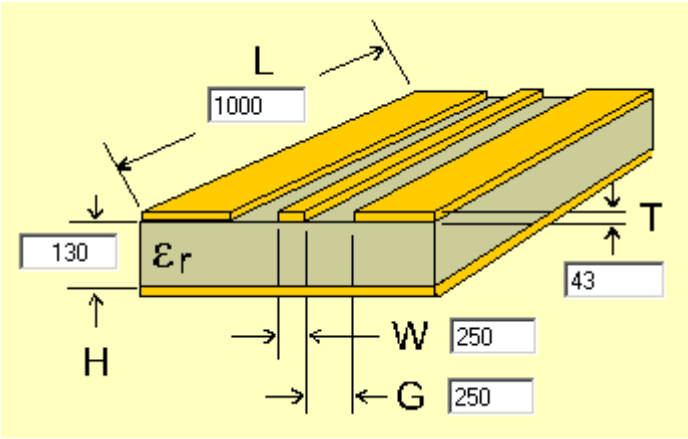


Figure 14: Micro strip on a multi layer board (Agilent AppCAD Coplanar Waveguide)

2.8 Antenna and Antenna Supervisor

u-blox 5 modules receive L1 band signals from GPS and GALILEO satellites at a nominal frequency of 1575.42 MHz. The RF signal is connected to the **RF_IN** pin.

u-blox 5 modules can be connected to passive or active antennas.

☞ For u-blox 5 receivers, the total preamplifier gain (minus cable and interconnect losses) must not exceed 50 dB. Total noise figure should be below 3 dB.

2.8.1 Passive Antenna

A design using a passive antenna requires more attention regarding the layout of the RF section. Typically a passive antenna is located near electronic components; therefore care should be taken to reduce electrical 'noise' that may interfere with the antenna performance. Passive antennas do not require a DC bias voltage and can be directly connected to the RF input pin **RF_IN**. Sometimes, they may also need a passive matching network to match the impedance to 50 Ohms.

☞ Some passive antenna designs present a DC short to the RF input, when connected. If a system is designed with antenna bias supply AND there is a chance of a passive antenna being connected to the design, consider a short circuit protection.

☞ All u-blox 5 receivers have a built-in LNA required for passive antennas.

2.8.2 Active Antenna

NEO-5 modules do not provide the antenna bias voltage for active antennas at the RF_IN pin. See Section 2.5.2 for more information.

2.8.3 Active Antenna Supervisor

NEO-5 modules do not support the Antenna Supervisor.

2.9 ESD Protection Measures

GPS receivers are Electrostatic Sensitive Devices (ESD). Special precautions are required when handling (see Section 3.4).

2.9.1 ESD Precautions for USB

In addition to handling precautions, design measures can protect the GPS device from potential damage caused by Electrostatic surges. With USB interfaces, protection devices (e.g. ST Microelectronics USBLC6-2) can introduce ESD resistance into the design. Carefully considering the layout is very important. ESD protection devices should be placed as close as possible to the sources of possible ESD disturbance (e.g. connectors). Figure 15 shows an example of using ESD protection with a USB connection. The data lines between I/O pins, from VDD_USB to VBUS pin and from GND plane to GND pin should be as short as possible.

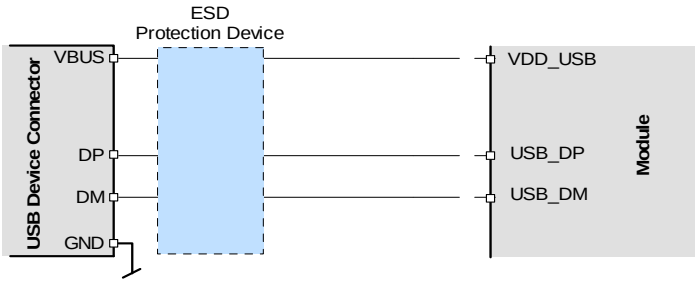


Figure 15: ESD protection for USB designs

2.9.2 ESD Precautions for Antennas

Antennas are an area of particular ESD sensitivity for GPS receivers. For improved resistance to external transient voltage spikes ESD protection circuits can be used. For passive antennas introduce a coil between the module and the patch (see Figure 16). By using a low capacitance ESD protection diode in an active antenna design it is possible to achieve ESD protection IEC-61000-2-4 Level 1 (see Figure 17).

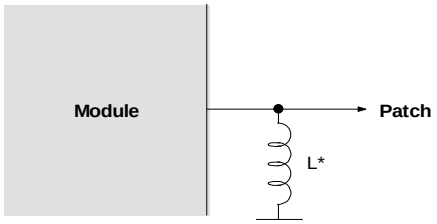


Figure 16: ESD Protection Circuit for Passive Antenna

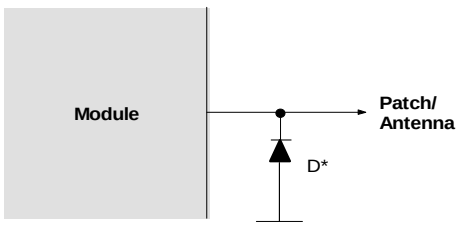


Figure 17: ESD Protection Circuit for Active Antenna

Component	Example
L*	IND MURATA LQG15H 0402 27N 5% 300MA
D*	ESD9L5.0ST5G Vant >3.3V ESD9R3.3ST5G ESD9L3.3ST5G

Table 4: Protection Circuit Components

3 Product Handling

☞ All NEO-5 modules are RoHS compliant (lead-free).

3.1 Packaging

NEO-5 modules are delivered as hermetically sealed, reeled tapes in order to enable efficient production, production lot set-up and tear-down.

Figure 18: Reeled u-blox 5 Modules

3.1.1 Reels

NEO-5 modules for GPS and GALILEO are deliverable in quantities of 250pcs on a reel. The dimensions of the reel are shown in *Figure 19*.

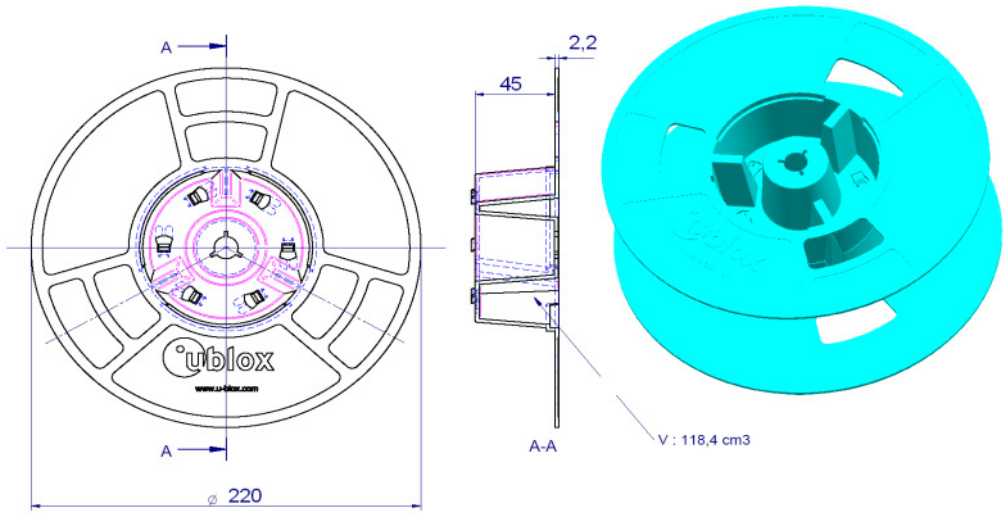


Figure 19: Dimension of reel for 250 pieces (dimensions in mm unless otherwise specified)

3.1.2 Tapes

The dimensions and orientations of the tapes for NEO 5 modules are specified in Figure 20.

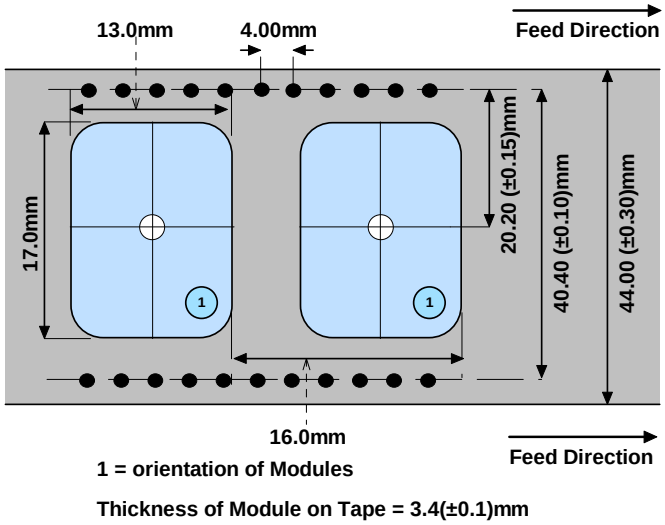


Figure 20: Dimensions and orientation for NEO-5 modules on tape

3.2 Shipment, Storage and Handling

3.2.1 Handling

u-blox 5 modules are designed and packaged to be processed in an automatic assembly line, and are shipped in Tape-and-Reel.

These components contain highly sensitive electronic circuitry. Handling the NEO-5 modules without proper ESD protection may destroy or damage them permanently.

According to JEDEC ISP, NEO-5 modules are moisture sensitive devices. Appropriate handling instructions and precautions are summarized in *Sections 3.2.2* to *3.2.5.* Read them carefully to prevent permanent damages due to moisture intake.

3.2.2 Shipment

The NEO-5 modules are delivered on Tape-and-Reels in a hermetically sealed package ("dry bag") to prevent moisture intake and protect against electrostatic discharge. For protection from physical damage, the reels are individually packed in cartons.

The dry bag provides a JEDEC compliant MSD label (Moisture Sensitive Devices) describing the handling requirements to prevent humidity intake.

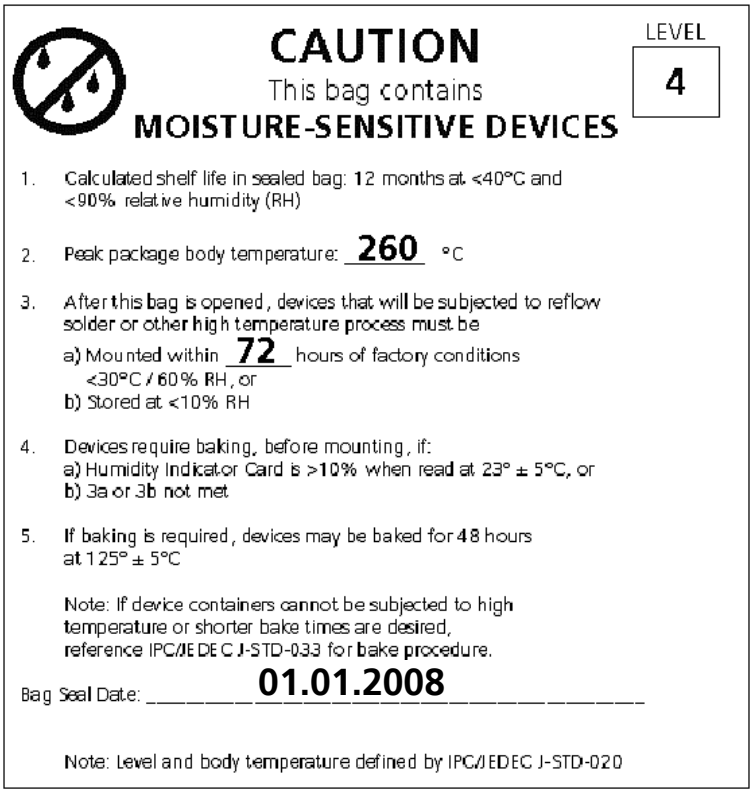


Figure 21: Applicable MSD Label (See *Section 3.1* for baking instructions)

3.2.3 Storage

Shelf life in sealed bag is 12 months at <40°C and <90% relative humidity.

3.2.4 Handling

A humidity indicator card and a desiccant bag to absorb humidity are enclosed in the sealed package. The parts are shipped on tape-and-reel in a hermetically sealed package. If no moisture has been absorbed, the three fields in the humidity indicator card indicate blue color.

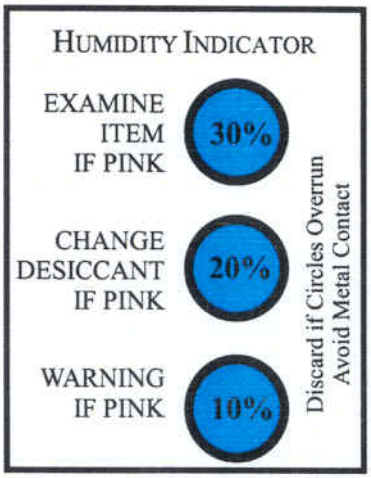


Figure 22: Humidity Indicator Card, good condition

3.2.5 Floor Life

For products with moisture sensitivity level 4, the floor life is 72 hours, or precisely three days. Under factory floor temperature and humidity conditions (<30°C, <60% relative humidity), the parts must be processed and soldered within this specified period of time.

Once the sealed package of the reel is opened and the parts exposed to humidity, they need to be processed within 72 hours (precisely three days) in a reflow soldering process. If this time is exceeded, or the sticker in the sealed package indicates that the goods have been exposed to moisture, the devices need to be pre-baked before the flow solder process. Please refer to *Section 3.3* for instructions on how to pre-bake the components.

3.3 Processing

3.3.1 Moisture Preconditioning

Both encapsulant and substrate materials absorb moisture. JEDEC specification J-STD-020 must be observed to prevent cracking and delamination associated with the "popcorn" effect during solder reflow. The popcorn effect can be described as miniature explosions of evaporating moisture. Baking before processing is required in following cases:

- Humidity indicator card: At least one circular indicator is no longer blue
- Floor life or environmental requirements after opening the seal is opened has been exceeded, e.g. exposure to excessive seasonal humidity.

Recommended baking procedure:

Duration: 48 hours

Temperature: 125°C

Humidity: Below 5%. Desiccant must be placed into the oven to keep humidity low.

Oven: Convection flow oven. Also put desiccant pack into the oven for dehydration.

After work: Put the baked components with desiccant and moisture indicator into a humidity proof bag and use a vacuum hot barrier sealing machine for sealing if not processed within specified floor time. Storage in a nitrogen cabinet or dry box is also a possible approach to prevent moisture intake.

Do not attempt to bake NEO-5 modules contained in tape and rolled up in reels. If baking is necessary first remove the modules from the belt and place them individually onto the oven tray, then bake them at 125°C for 48 hours.

A repeated baking process will reduce the wetting effectiveness of the pad contacts. This applies to all SMT devices.

3.3.2 Soldering Paste

Use of "No Clean" soldering paste is strongly recommended, as it does not require cleaning after the soldering process has taken place. The paste listed in the example below meets these criteria.

Soldering Paste: LFSOLDER TLF-206-93F (Tamura Kaken (UK) Ltd.)

Alloy specification: Sn 95.5/ Ag 3.9/ Cu 0.6 (95.5% Tin/ 0.6 % Silver/ 0.6% Copper)

Melting Temperature: 216 - 221°C

Stencil Thickness: 150 µm for base boards

The final choice of the soldering paste depends on the approved manufacturing procedures.

The paste-mask geometry for applying soldering paste should meet the recommendations in section 2.7.2

The quality of the solder joints on the connectors ('half vias') should meet the appropriate IPC specification.

3.3.3 Reflow Soldering

A convection type-soldering oven is strongly recommended over the infrared type radiation oven. Convection heated ovens allow precise control of the temperature and all parts will be heated up evenly, regardless of material properties, thickness of components and surface color.

Consider the "IPC-7530 Guidelines for temperature profiling for mass soldering (reflow and wave) processes, published 2001".

Preheat Phase

Initial heating of component leads and balls. Residual humidity will be dried out. Please note that this preheat phase will not replace prior baking procedures.

- Temperature rise rate: 1 - 4°C/s — If the temperature rise is too rapid in the preheat phase it may cause excessive slumping.
- Time: 60 – 120 seconds — If the preheat is insufficient, rather large solder balls tend to be generated. Conversely, if performed excessively, fine balls and large balls will be generated in clusters.
- End Temperature: 150 - 200°C — If the temperature is too low, non-melting tends to be caused in areas containing large heat capacity.

Heating/ Reflow Phase

The temperature rises above the liquidus temperature of 216 - 221°C. Avoid a sudden rise in temperature as the slump of the paste could become worse.

- Limit time above 220°C liquidus temperature: 20 - 40s
- Peak reflow temperature: 230 - 250°C

Cooling Phase

A controlled cooling avoids negative metallurgical effects (solder becomes more brittle) of the solder and possible mechanical tensions in the products. Controlled cooling helps to achieve bright solder fillets with a good shape and low contact angle.

- Temperature fall rate: max 3°C / s

☞ To avoid falling off, the u-blox 5 GPS/GALILEO module should be placed on the topside of the motherboard during soldering.

The final soldering temperature chosen at the factory depends on additional external factors like choice of soldering paste, size, thickness and properties of the base board, etc. Exceeding the maximum soldering temperature in the recommended soldering profile may permanently damage the module.

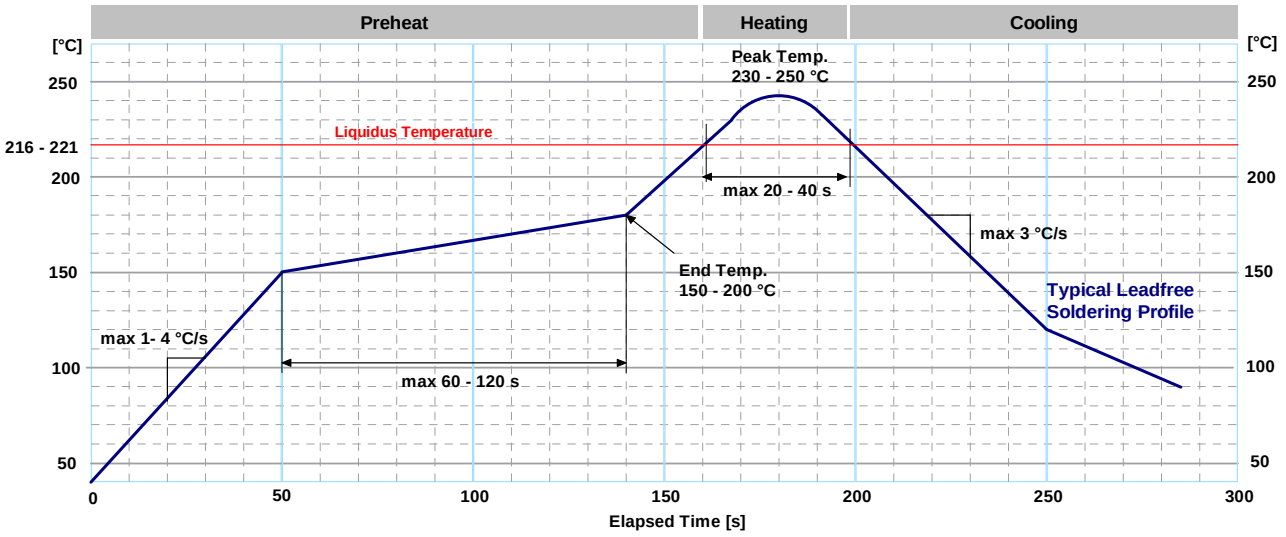


Figure 23: Recommended soldering profile

When soldering leadfree (u-blox 5) modules in a leaded process, check the following temperatures:

- PB- Technology Soaktime: 40-80sec
- Time above Liquidus: 40-90 sec
- Peak temperature: 225-235 °C

NEO-5 modules must not be soldered with a damp heat process.

3.3.4 Optical Inspection

After soldering the NEO-5 module, consider an optical inspection step to check whether:

- The module is properly aligned and centered over the pads
- All pads are properly soldered
- No excess solder has created contacts to neighboring pads, or possibly to pad stacks and vias nearby.

3.3.5 Cleaning

In general, cleaning the populated modules is strongly discouraged. Residues underneath the modules cannot be easily removed with a washing process.

- Cleaning with water will lead to capillary effects where water is absorbed in the gap between the baseboard and the module. The combination of residues of soldering flux and encapsulated water leads to short circuits or resistor-like interconnections between neighboring pads. Water will also damage the sticker and the ink-jet printed text.
- Cleaning with alcohol or other organic solvents can result in soldering flux residues flooding into the two housings, areas that are not accessible for post-wash inspections. The solvent will also damage the sticker and the ink-jet printed text.
- Ultrasonic cleaning will permanently damage the module, in particular the quartz oscillators.

The best approach is to use a "no clean" soldering paste and eliminate the cleaning step after the soldering.

3.3.6 Repeated Reflow Soldering

Only a single reflow soldering process is encouraged for boards with a NEO-5 module populated on it. The reason for this is the risk of the module falling off due to high weight in relation to the adhesive properties of the solder.

3.3.7 Wave Soldering

Base boards with combined through-hole technology (THT) components and surface-mount technology (SMT) devices require wave soldering to solder the THT components. Only a single wave soldering process is encouraged for boards populated with NEO-5 modules.

3.3.8 Hand Soldering

Hand soldering is allowed. Use a soldering iron temperature setting of "7" which is equivalent to 350°C and carry out the hand soldering according to the IPC recommendations / reference documents IPC7711.

Place the module precisely on the pads. Start with a cross-diagonal fixture soldering (e.g. pins 1 and 16), and then continue from left to right.

3.3.9 Rework

The NEO-5 module can be unsoldered from the baseboard using a hot air gun.

Avoid overheating the module.

After the module is removed, clean the pads before placing and hand-soldering a new module.

Never attempt a rework on the module itself, e.g. replacing individual components. Such actions immediately terminate the warranty.

3.3.10 Conformal Coating

Certain applications employ a conformal coating of the PCB using HumiSeal® or other related coating products.

These materials affect the HF properties of the GPS module and it is important to prevent them from flowing into the module.

The RF shields do not provide 100% protection for the module from coating liquids with low viscosity, therefore care is required in applying the coating.

☞ Conformal Coating of the module will void the warranty.

3.3.11 Casting

If casting is required, use viscose or another type of silicon pottant. The OEM is strongly advised to qualify such processes in combination with the NEO-5 module before implementing this in the production.

☞ Casting will void the warranty.

3.3.12 Grounding Metal Covers

Attempts to improve grounding by soldering ground cables, wick or other forms of metal strips directly onto the EMI covers is done at the customer's own risk. The numerous ground pins should be sufficient to provide optimum immunity to interferences and noise.

☞ u-blox makes no warranty for damages to the NEO-5 module caused by soldering metal cables or any other forms of metal strips directly onto the EMI covers.

3.3.13 Use of Ultrasonic Processes

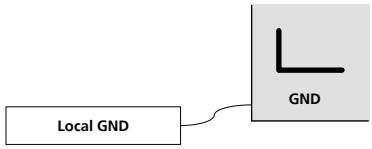
Some components on the NEO-5 module are sensitive to Ultrasonic Waves. Use of any Ultrasonic Processes (cleaning, welding etc.) may cause damage to the GPS Receiver.

☞ u-blox offers no warranty against damages to the NEO-5 module caused by any Ultrasonic Processes.

3.4 ESD Handling Precautions

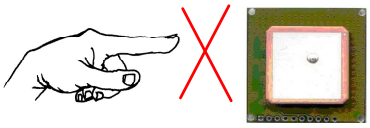
GPS receivers are Electrostatic Sensitive Devices (ESD) and require special precautions when handling. Particular care must be exercised when handling patch antennas, due to the risk of electric charges. In addition to standard ESD safety practices, the following measures should be taken into account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

- Unless there is a galvanic coupling between the local GND (i.e. the work table) and the PCB GND, then the first point of contact when handling the PCB shall always be between the local GND and PCB GND.

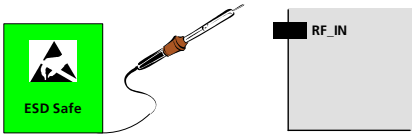


- When handling the RF pin, do not come into contact with any charged capacitors and be careful when contacting materials that can store charges (e.g. patch antenna ~10pF, coax cable ~50-80pF/m, soldering iron, …)

- To prevent electrostatic discharge through the RF input do not touch the mounted patch antenna.



- When soldering RF connectors and patch antennas to the receiver's RF pin, make sure to use an ESD safe soldering iron (tip).



Failure to observe these precautions can result in severe damage to the GPS receiver!

For ESD protection design measures see Section 2.9.

4 Product Testing

4.1 u-blox In-Series Production Test

u-blox focuses on high quality for its products. To achieve a high standard it's our philosophy to supply fully tested units. Therefore at the end of the production process, every unit is tested. Defective units are analyzed in detail to improve the production quality.

This is achieved with automatic test equipment, which delivers a detailed test report for each unit. The following measurements are done:

- Digital self-test (Software Download, verification of FLASH firmware, etc.)
- Measurement of voltages and currents
- Measurement of RF characteristics (e.g. C/No)

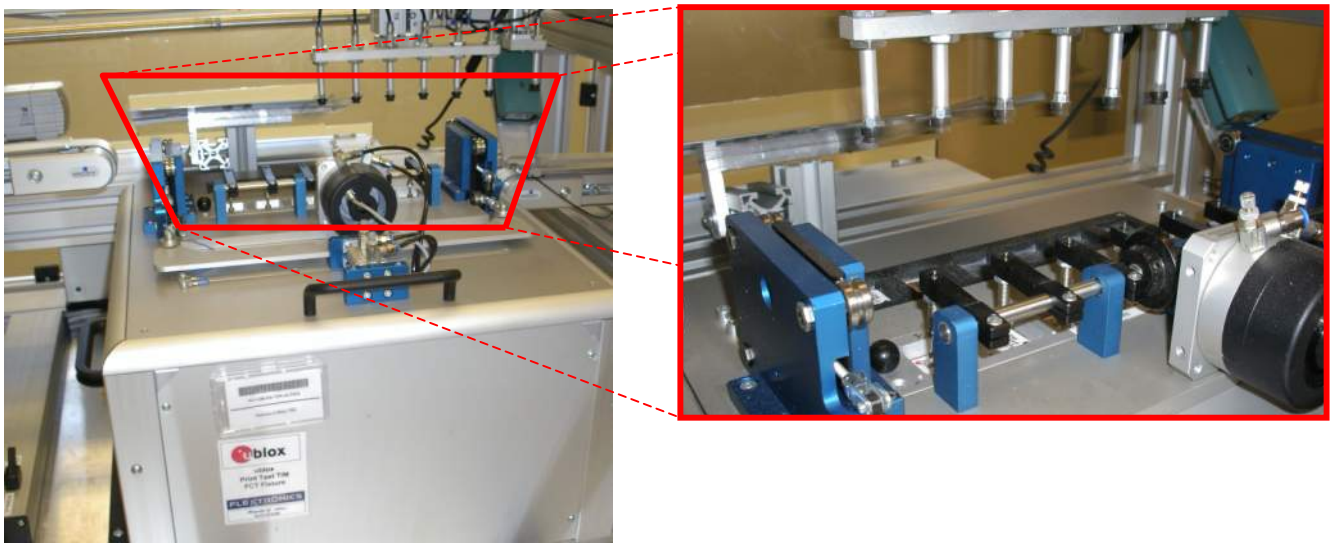


Figure 24: Automatic Test Equipment for Module Tests

4.2 Test Parameters for OEM Manufacturer

Because of the testing done by u-blox (with 100% coverage), it is obvious that an OEM manufacturer doesn't need to repeat firmware tests or measurements of the GPS parameters/characteristics (e.g. TTFF) in their production test.

An OEM Manufacturer should focus on

- Overall sensitivity of the device (including antenna, if applicable)
- Communication to a host controller

4.3 System Sensitivity Test

The best way to test the sensitivity of a GPS device is with the use of a 1-channel GPS simulator. It assures reliable and constant signals at every measurement.

Figure 25: 1-channel GPS simulator

u-blox recommends the following Single-Channel GPS Simulator:

- Spirent GSS6100
  Spirent Communications Positioning Technology
  (previously GSS Global Simulation Systems) www.positioningtechnology.co.uk

4.3.1 Guidelines for Sensitivity Tests

1. Connect a 1-channel GPS simulator to the OEM product
2. Choose the power level in a way that the "Golden Device" would report a C/No ratio of 38-40 dBHz
3. Power up the DUT (Device Under Test) and allow enough time for the acquisition
4. Read the C/No value from the NMEA GSV or the UBX-NAV-SVINFO message (e.g. with u-center AE)
5. Compare the results to a "Golden Device" or a u-blox 5 Evaluation Kit.

4.3.2 'Go/No go' tests for integrated devices

The best test is to bring the device to an outdoor position **with excellent sky view** (HDOP < 3.0). Let the receiver acquire satellites and compare the signal strength with a "Golden Device".

☞ As the electro-magnetic field of a redistribution antenna is not homogenous, indoor tests are in most cases not reliable. These kind of tests may be useful as a 'go/no go' test but not for sensitivity measurements.

A Migration to u-blox 5 receivers

Migrating ANTARIS®4 to a u-blox 5 GPS/GALILEO receiver is a straightforward procedure. Nevertheless there are some points to be considered during the migration.

☞ Not all of the functionalities available with ANTARIS®4 are supported by u-blox 5. These include:

- FixNow Mode
- Low Power Modes
- RTCM
- UTM

A.1 Migration from NEO-4S to NEO-5Q/NEO-5M

The pin-outs of NEO-4S and NEO-5M/NEO-5Q differ slightly. Table 5 compares the modules and highlights the differences to be considered.

Pin	NEO-4S		NEO-5Q/NEO-5M		Remarks for Migration
	Pin Name	Typ. Assignment	Pin Name	Typ. Assignment	
1	**BOOT_INT**	NC	**Reserved**	NC	do not drive low.
2	**SELECT**	VDDIO level I/O; not connected	**NC/ SS_N**	NC	NEO-5M: NC NEO-5Q: SS_N
3	**TIMEPULSE**	VDDIO level I/O	**TIMEPULSE**	Output	
4	**EXTINT0**	NC	**EXTINT0**	NC	
5	**USB_DM**	NC	**USB_DM**	NC	
6	**USB_DP**	NC	**USB_DP**	NC	
7	**VDDUSB**	Connected to GND or VDD_USB	**VDDUSB**	Connected to GND or VDD_USB	Do not leave open. (VDD_USB is 3.3V regulated power supply from VBUS.)
8	**Reserved**	NC	**Reserved**	NC	Pins 8 and 9 must be connected.
9	**VCC_RF**	VCC-0.1V	**VCC_RF**	VCC-0.1V	No difference
10	**GND**	GND	**GND**	GND	No difference
11	**RF_IN**	RF_IN	**RF_IN**	RF_IN	No difference
12	**GND**	GND	**GND**	GND	No difference
13	**GND**	GND	**GND**	GND	No difference
14	**MOSI**	NC	**MOSI/CFG_COM0**	NC	The function of the CFG pin has changed. See Section 2.5.3 for more details.
15	**MISO**	NC	**MISO//CFG_COM1/ NC**	NC	
16	**SCK/ CFG_USB**	RF_IN	**SCK/CFG_GPS0/ NC**	NC	Leave open if not used. The function of the CFG pin has changed. See Section 2.5.3 for more details.
17	**NCS**	NC	**SCS1_N/ NC**	NC	No difference
18	**Reserved**	NC	**SDA2**	NC	
19	**Reserved**	NC	**SCL2**	NC	
20	**TXD1**	VDDIO level I/O	**TxD1**	Output	
21	**RXD1**	VDDIO level I/O	**RxD1**	Input	Leave open if not used.
22	**V_BAT**	1.5-3.6V	**V_BCKP**	1.4-3.6V	Wider voltage range but needs more current. Check your backup supply, regarding the higher consumption.
23	**VCC**	2.7-3.3V	**VCC**	2.7-3.6V	Higher peak supply current
24	**GND**	GND	**GND**	GND	No difference

: Pins to be checked carefully; NC: Not connected

Table 5: Pin-out comparison NEO-4S vs. NEO-5

B Lists

B.1 List of Figures

B.2 List of Tables

C Glossary

API	Application Programming Interface
BBR	Battery backup RAM
ECEF	Earth Centered Earth Fixed
ESD	Electro Static Discharge
HAE	Height Above WGS84-Ellipsoid
LNA	Low Noise Amplifier
LOS	Line of sight,
NMEA 0183	ASCII based standard data communication protocol used by GPS receivers.
PUBX	u-blox proprietary extension to the NMEA protocol
PVT	Position Velocity Time
SA	Selective Availability
SV	Satellite Vehicle
SBAS	Satellite Based Augmentation Systems
UBX	File extension for u-center log file or short form for the UBX protocol
UBX Protocol	A proprietary binary protocol used by the ANTARIS™ GPS technology

Related Documents

[1] GNSS Compendium, Doc No GPS-X-02007

[2] NEO-5 Data Sheet, Doc No GPS.G5-MS5-07025

[3] u-blox 5 Protocol Specification, Doc No GPS.G5-X-07063

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

[5] SPI Implementation Application Note, Docu. No GPS.G5-X-08028

[6] GPS Antenna Application Note, Docu. No GPS-X-08014 (to be released 01/2009)

[7] u-blox 5 Power Management Application Note, Docu. No GPS.G5-CS-08022 (to be released 01/2009)

All these documents are available on our homepage (http://www.u-blox.com).

Contact

For further info, please contact us:

Headquarters

u-blox AG

Zuercherstrasse 68
CH-8800 Thalwil
Switzerland

Phone: +41 44 722 74 44
Fax: +41 44 722 74 47
E-mail: info@u-blox.com

www.u-blox.com

Offices

North, Central and South America

u-blox America, Inc.

1902 Campus Commons Drive
Suite 310
Reston, VA 20191
USA

Phone: +1 (703) 483 3180
Fax: +1 (703) 483 3179
E-mail: info_us@u-blox.com

Regional Office West Coast:

Phone: +1 (703) 483 3184
Fax: +1 (703) 483-3179
E-mail: info_us@u-blox.com

Technical Support:

Phone: +1 (703) 483 3185
E-mail: support_us@u-blox.com

Europe, Middle East, Africa

u-blox AG

Zuercherstrasse 68
CH-8800 Thalwil
Switzerland

Phone: +41 44 722 74 44
Fax: +41 44 722 74 47
E-mail: info@u-blox.com

Technical Support:

Phone: +41 44 722 74 44
E-mail: info@u-blox.com

Asia, Australia, Pacific

u-blox Singapore Pte. Ltd.

435 Orchard Road
#17-01, Wisma Atria,
Singapore 238877

Phone: +65 6734 3811
Fax: +65 6736 1533
E-mail: info_ap@u-blox.com
Support: support_ap@u-blox.com

Regional Office China:

Room 716-718
No. 65 Fuxing Road
Beijing, 100036, China

Phone: +86 10 68 133 545
Fax: +86 10 68 217 890
E-mail: info_cn@u-blox.com
Support: support_cn@u-blox.com

Regional Office Japan:

6F Akasaka Yoko Building,
4-8-6, Akasaka Minato-ku
Tokyo 107-0052 Japan

Phone: +81 3 4360 5343
Fax: +81 3 4360 5301
E-mail: info_jp@u-blox.com
Support: support_jp@u-blox.com

Regional Office Korea:

Room 501, Gyeong Hui Building 109-18,
Samseong-Dong,
GangNam-Gu,
Seoul, Korea 135-090

Phone: +82 2 542 0861
Fax: +82 2 542 0862
E-mail: info_kr@u-blox.com
Support: support_kr@u-blox.com

Regional Office Taiwan:

Room 305
3F, #181, ZouTze Street
Neihu Dis.
Taipei, Taiwan

Phone: +886 2 2657 1090
Fax: +886 2 2657 1097
E-mail: info_tw@u-blox.com
Support: support_tw@u-blox.com