u-blox NEO-M9V migration guide

Migrating from professional grade NEO-M8U and NEO-M8L to NEO-M9V modulemodule

Application note for industrial applications

Abstract

This document provides an overview of the most important software and hardware changes from u-blox NEO-M8U and NEO-M8L modules to the u-blox NEO-M9V module.

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This document applies to the following products:

Product name	Type number	Firmware version
NEO-M9V	NEO-M9V-20B-00	MDR 2.10
NEO-M8U	NEO-M8U-06B-00	UDR 1.50
NEO-M8L	NEO-M8L-06B-00	ADR 4.50
NEO-M8U	NEO-M8U-05B-00	UDR 1.31
NEO-M8U	NEO-M8U-04B-00	UDR 1.21
NEO-M8U	NEO-M8U-0-10	UDR 1.0

Contents

1 Overview

This document provides an overview of the software and hardware changes introduced in the u-blox M9 module product NEO-M9V, to support migration from the existing module design based on the u-blox M8 dead reckoning module including 3D inertial sensors.

NEO-M9V supports a standard precision GNSS platform with 3D multi-mode dead reckoning (MDR). u-blox M9 receivers support concurrent reception of four GNSS.

NEO-M9V-20B is the first u-blox GNSS receiver with untethered (UDR) and automotive dead reckoning (ADR), specially designed for fleet management and micromobility applications. It directly succeeds the u-blox M8 product range, namely the NEO-M8U and NEO-M8L professional grade modules.

NEO-M9V is available in professional grade.

Multi-mode dead reckoning (MDR): u-blox's proprietary multi-mode dead reckoning (MDR) consists of two operating modes: untethered dead reckoning (UDR) and automotive dead reckoning (ADR). UDR is based on SFDR technology, which combines multi-constellation GNSS measurements with NEO-M9V's internal 6-axis IMU only. ADR is based on sensor fusion dead reckoning (SFDR) technology, which combines multi-constellation GNSS measurements with NEO-M9V's internal 6-axis IMU and wheel tick or speed.

1.1 Documentation

- Data sheet [1] focuses on essential parameters and performance figures of NEO-M9V.
- Firmware release note [2] gives information on the firmware features and configuration and message interfaces.
- Integration manual [3] provides detailed information on receiver configuration and hardware integration.
- Interface description [4] covers the supported protocols (UBX, NMEA) with a detailed description of the messages.
- Data sheet [5] focuses on essential parameters and performance figures of NEO-M8U.
- Data sheet [6] focuses on essential parameters and performance figures of NEO-M8L.

2 Software changes

This section summarizes the main software changes in NEO-M9V compared to u-blox NEO-M8U and NEO-M8L.

The new features include wake on motion, advanced calibration handling, secondary navigation output, and different dynamic models. Moreover, UDR performance is improved in terms of the vibration handling, speed bumps and bumper-to-bumper traffic, during abrupt speed changes in a tunnel or underground parking, and in reduced fly-away scenarios when a receiver has been turned on or off.

u-blox M9 receivers detect jamming and spoofing events and report them to the host, which allows the system to react to such events. RF design effort for NEO-M9V-20B is reduced, as a SAW filter and an LNA are integrated. Advanced filtering algorithms mitigate the impact of RF interference and jamming, thus enabling the product to operate as intended.

A new kick e-scooter dynamic model has been introduced in this release. In addition to the sensor-fused position solution, a second output delivers an independent GNSS-only positioning solution.

The receiver also provides a higher navigation rate and improved security features compared to previous u-blox GNSS generations.

This release adds support for NMEA message output from the secondary filter and introduces the ability to use wheel tick (WT) data without the directional input to reach a sensor fusion fix.

A new message, UBX-ESF-CAL, has been implemented along with support to output calibrated raw sensor measurements at 100 Hz. Another new message, UBX-NAV-PVAT, has been implemented to improve debugging and unify the navigation solution output.

For detailed information on the software, refer to the u-blox MDR 2.10 Interface description [4], the u-blox M9 MDR 2.10 firmware Release note [2], and the Integration manual [3].

2.1 Summary of software changes

Feature	Change	Action needed
Configuration	New configuration interface using UBX-CFG-VALSET, UBX-CFG-VALGET and UBX-CFG-VALDEL messages. Use of old configurations is prohibited.	Code change
E-scooter dynamic model	A new kick e-scooter dynamic model has been introduced in this release. This can be configured by setting CFG-NAVSPG-DYNMODEL to 12.	Code change
Firmware	NEO-M9V can execute firmware from the receiver RAM. An external firmware image can be downloaded from an SPI flash memory and executed on receiver RAM. External firmware is no longer executed from flash memory.	-
Boot screen	Product identifier in boot screen and polling UBX-MON-VER: EXT CORE 1.00 (501c661), FWVER= MDR 2.10, PROTVER=35.10.	Code change (optional)
Default baud rate	Default baud rate at UART 38400 baud.	Code change
Default GNSS	GPS L1 C/A, Galileo E1-B/C, BeiDou B1I, GLONASS L1OF, QZSS L1 C/A, and SBAS L1 C/A.	Code change (optional)
Navigation update rate	Navigation update rate up to 50 Hz in the priority navigation mode.	Code change (optional)
IMES	Not supported.	Code change (optional)
Assisted GNSS	AssistNow Online supported	-

AssistNow Offline and AssistNow Autonomous	Not supported.	Code change
NMEA	There are four NMEA standards supported. The default NMEA version is 4.11. Alternatively, versions 4.10, 4.0, 2.3, and 2.1 can be enabled.	Code change (optional)
UBX	This firmware supports the UBX Protocol Version 35.10.	Code change
RTCM2.3	Not supported	Code change
Configuration lock	New feature. Receiver configuration can be locked by command.	Code change (optional)
Advanced calibration handling	New feature. Calibration information can be stored with the host.	Code change
Automotive Dead Reckoning	New feature. Combines satellite and sensor-based navigation (IMU and odometer input)	Code change
Wake on motion	New feature. Wakes up the receiver and the host while the receiver is in SW backup mode	Code change
Calibrated sensor output	A new message UBX-ESF-CAL has been implemented along with support to output calibrated raw sensor measurements at 100 Hz. The implementation outputs calibrated measurements in IMU frame and does not check for invalid calibration.	Code change
RF spectrum view	New message. UBX-MON-SPAN shows in-band RF spectrum around the GNSS band. This can be used to identify potential in-band RF interference sources in the design.	Code change (optional)
Software	The u-center version 21.12 (or later) should be used together with this released product	-
Data logging on Flash	Position, velocity, and time data logging on the flash device is not supported in this release.	-

Table 1: Summary of software changes

2.2 Configuration concept

A new configuration concept is introduced. Many legacy UBX-CFG group messages have been deprecated and replaced by new configuration messages UBX-CFG-VALSET, UBX-CFG-VALGET, and UBX-CFG-VALDEL. Refer to the Interface description [4] for a description of this feature and the available settings. This allows direct access to individual configuration items (typically individual fields in the deprecated legacy UBX-CFG group messages). The configuration items can be applied independently on RAM, BBR, and flash memory layers.

3 Hardware changes

The NEO-M9V module is not 1:1 pin-compatible with u-blox M8 modules. The pin layout and the function of the pins have changed. The following sections list the key differences between NEO-M9V and NEO-M8 modules. Refer to the product Data sheet [1] and Integration manual [3] for technical specifications and design support. The wake-on-motion functionality that allows turning off the host and saving power until motion is detected by the IMU.

RF design effort for NEO-M9V-20B is reduced, as a SAW filter and an LNA are integrated. Advanced filtering algorithms mitigate the impact of RF interference and jamming, thus enabling the product to operate as intended.

The NEO-M9V module is available in the NEO form factor, which is a 12.2 x 16.0 mm LCC package.

3.1 Summary of hardware changes

Feature	Change	Action needed
Module pin-out	New module pin-out, a 1:1 u-blox M8 module replacement may not be possible in old designs. New and changed pin specification.	Check existing design and new pin-out PCB routing change might be required
External components	NEO-M9V has an internal DC block and 50 Ω impedance matching for GNSS signal input, so there is no need to add these components to the RF path.	Hardware change (optional)
Power supplies	New V_BCKP supply voltage specification. The backup battery current rating changed.	Hardware change (optional) Check backup battery capacity
Wake on motion (WOM Pin)	NEO-M9V pin 17 (WOM) is available as the wake-on-motion output. By default, wake on motion is disabled.	Hardware change
Wheel Tick	NEO-M9V pin 4 (WT) is available as a wheel-tick input. By default the wheel tick count is derived from the rising edges of the WT input. Alternatively, the vehicle WT (or speed) and DIR inputs can be provided via one of the communication interfaces with UBX-ESF-MEAS messages. In this use case, the WT pin can be configured as EXTINT to provide a time-mark for the UBX-ESF-MEAS messages. The DIR pin can be left open.	Hardware change (optional)
DIR	Pin 15 (DIR) is available as a direction input. The DIR input shall indicate whether the vehicle is moving forwards or backwards. The DIR pin polarity can also be configured with the CFG-SFODO-DIR_PINPOL key. Alternatively, the vehicle WT (or speed) and DIR inputs can be provided via one of the communication interfaces with UBX-ESF-MEAS messages. In this use case, the WT pin can be configured as EXTINT to provide a time-mark for the UBX-ESF-MEAS messages. The DIR pin can be left open.	Hardware change (optional)
Digital IO	New electrical specification for digital IO pins (incl. UART, I2C, SPI). External isolation required if hardware backup mode is used.	Hardware change
USB	Due to hardware implementation, it may not be possible to certify the USB interface.	-
UART	Neither handshaking signals nor hardware flow control signals are available. The UART interface protocol and baud rate can be configured but there is no support for setting different baud rates for reception and transmission.	Hardware change (optional)
RF input	New RF input specification. Change in receiver chain noise figure and external gain (at RF_IN) 30 dB Max.	Hardware change (optional)

Table 2: Summary of hardware changes

3.2 Digital IO isolation

Driving digital pins is not allowed in the NEO-M9V module (all I/O including UART and other interfaces to float or connect to a high impedance) in HW backup mode (V_BCKP supplied when VCC is removed). This is to avoid cross-supplying the receiver via digital pins. External isolation may be required, e.g., on the communication lines to the host controller. An example of digital IO isolation is given in the Communication interfaces section of the Integration manual [3].

Related documentation

[1] NEO-M9V-20B - Datasheet, UBX-21029781
[2] u-blox M9 MDR 2.10 firmware Release note, UBX-22000503
[3] NEO-M9V Integration manual, UBX-21029776
[4] MDR 2.10 Interface description, UBX-21036678
[5] NEO-M8U-06B-00 – Datasheet, UBX-15015679
[6] NEO-M8L-06B – Datasheet, UBX-20058645

☞ For product change notifications and regular updates of u-blox documentation, register on our website, www.u-blox.com.

Revision history

Revision	Date	Name	Comments
R01	26-Apr-2022	kkir	Initial release

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