KOSMINIS VYTIS

KV106

SINGLE ANTENNA HIGH PERFORMANCE OEM GNSS MODULE

PPP, RTK

Specification

March, 2024

CONTENTS

1. GENERAL INFORMATION

KV106 is single antenna high precision multi-GNSS OEM module in a compact form factor with the software and hardware platform which provides the navigation solution based on signals from all supported GNSS, increased update rates and access to the noise-reduced GNSS measurements. The **KV106** module supports concurrent reception of all specified GNSS constellations in multi bands, including S-band signals, that significantly mitigates the effect of multipath and improves positioning accuracy.

The module with integrated PPP and RTK Engines provides high accuracy positioning in both static and dynamic.

The **KV106** supports the following operation modes:

- autonomous mode (standalone mode), 20 Hz;
- PPP mode: it receives RTCM-SSR correction and calculates Position, Velocity, Time (PVT) with high accuracy, 20 Hz;
- RTK ROVER mode: it receives RTCM correction from the Base Station and calculates PVT with high accuracy, 20 Hz;
- RTK BASE mode: it provides the Novatel or RTCM3.4 output correction data for the Rover, 20 Hz.

Autonomous mode is standard GNSS method, also known as SINGLE mode. While using this method, the navigation solution (PVT) is only obtained from the GNSS constellations, there are no error corrections made.

PPP mode is positioning mode with high level of accuracy. PPP mode requires the RTCM-SSR corrections from PPP service providers. PPP engine is designed for PPP with floating ambiguities. The typical convergence time is between 20-30 minutes. For stable and reliable operation PPP requires at least one of two message sets: 1060+1066 or 1060+1243. The principle of PPP operation is based on the difference between the L1 and L2 carrier phases, therefore it is necessary to use antennas that support the L1, L2 GNSS signals reception. The actual the convergence time required is dependent on the quality of the correction products, satellite geometry, atmospheric conditions.

RTK ROVER mode is differential positioning mode whit algorithms that incorporate ambiguity solutions and RTCM correction data from the Base Station. The position accuracy achievable by the module (rover) depends on the baseline length used and the accuracy of the corrections data and position of the Base Station.

RTK BASE mode is raw GNSS measurements generation mode. In RTK BASE mode, **KV106** generates RTCM messages: 1004+1012, MSM7, 1005, 1006, 1007, 1008, 1019, 1020, 1046, 1041, 1042, 1230, 4064.100.

GNSS External Active Antenna Requirements:

- antenna voltage supply 5 V;
- maximum current 100 mA;
- LNA Gain Range (minus signal loss) 20 dB ...35 dB.

The external GNSS antenna(s) must have a clear line of sight to the sky during operation. Install the antenna with a clear view of the sky and clear of obstructions such as building, trees etc.

Rooftops, free from other structures with a direct view of the horizon, usually make good places to install.

This clear view allows antenna to track the maximum number of satellites during the day.

Don't install GNSS antenna near the windows of the building or indoors. When installing the GNSS antenna, choose a location where the antenna will not be covered by drifting snow or accumulated snow. It must not be covered with leaves or placed in a position where it could be blocked.

Avoid placing the GNSS antenna in close proximity to broadcast antennas, metal surfaces or powerful transmitters.

Satellite signal is blocked by the underground parking lots, bridges, tall buildings, large trees etc.

Try to choose a "lightning-protected zone".

Optimal performance will not be available in narrow streets or if the antenna is obstructed by objects.

When installing GNSS antennas separate them by at least 1 m.

Poor visibility may result in a position shift or an increase in Time To First Fix (TTFF).

Incorrect antenna placement can influence on navigation solution. Good visibility of the sky is an important condition for accurate positioning and confident reception.

2. TOP VIEW AND INDICATION

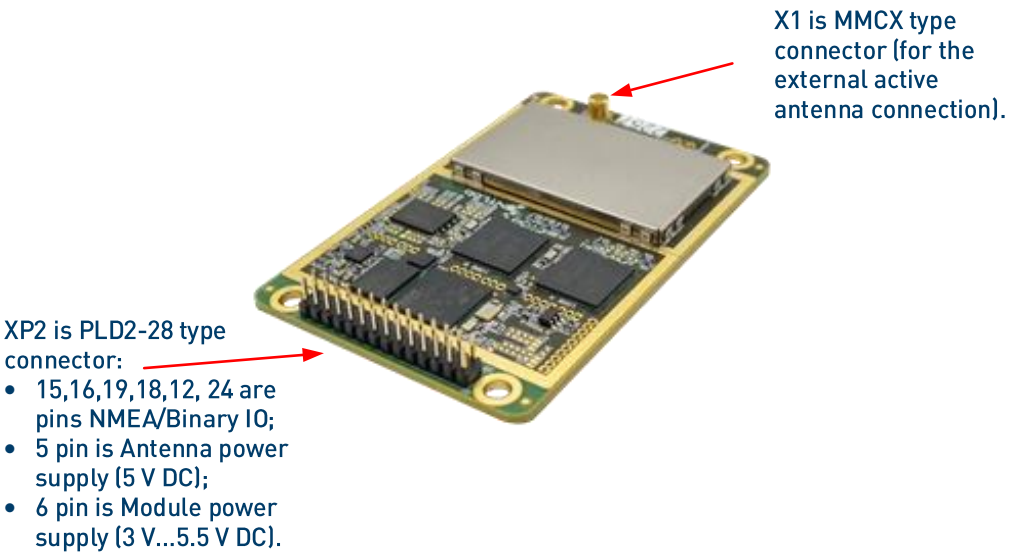

Figure 2.1 – **KV106** Top View[1]

KV106 is implemented on the chipsets designed by NTLab company:

- 1xNT1066 is a 4-channel L1, L2, L5, S bands Radio-Frequency Front-End (RF FE) integrated circuit for GNSS signals reception and their analog processing (for amplification, filtering and down converting of the received signals to a fixed intermediate frequency);
- 2xNT1058 are microcontrollers which include digital Baseband Processor and 128-channels hardware correlator (2x128) for signals tracking and primary processing of digital signals.

Connectors:

- X1 is MMCX type connectors for external active antenna commutation. Central pin provides DC voltage for antenna power supply. DC voltage is wired from Pin 5 of I/O Connector XP2. It means that a host-device must provide DC voltage in accordance with active antenna requirements for **KV106**.
  X1 connector is Primary antenna input;
- XP2 is a PLD2-28 connector. Form factor of the board and XP2 pin-out is compatible with popular GNSS receiver families (Novatel 6xx, Trimble and others). Refer to Chapter 5 for XP2 pin-out, refer to Chapter 6 for PCB dimensions.

[1] Actual appearance may differ from pictured

LEDs:

- yellow LED VD1 is indicator of the normal operation of the MCU. It blinks during normal operation;
- green LEDs VD2 (A) and VD4 (B) are indicators of the normal performance for 2xNT1058. It blinks once per second during normal operation;
- red LED VD3 (NT1066 AOK) is indicator of normal hardware operation of the analog RF FE part. It is OFF during normal operation. Otherwise, please, check active antenna circuitry. This may indicate not appropriate level of amplification in active antenna: too low or too high;
- green LED VD6 is indicator of the module power supply. Green Solid: means the board is powered properly;
- red LED VD7 is indicator of the Reset control (may not be installed);
- green LED VD8 is indicator of the antenna power supply. Green Solid: means the board is powered properly;
- red LED VD9 is antenna input short-circuit indicator. It is OFF during normal operation.

3. BLOCK DIAGRAM

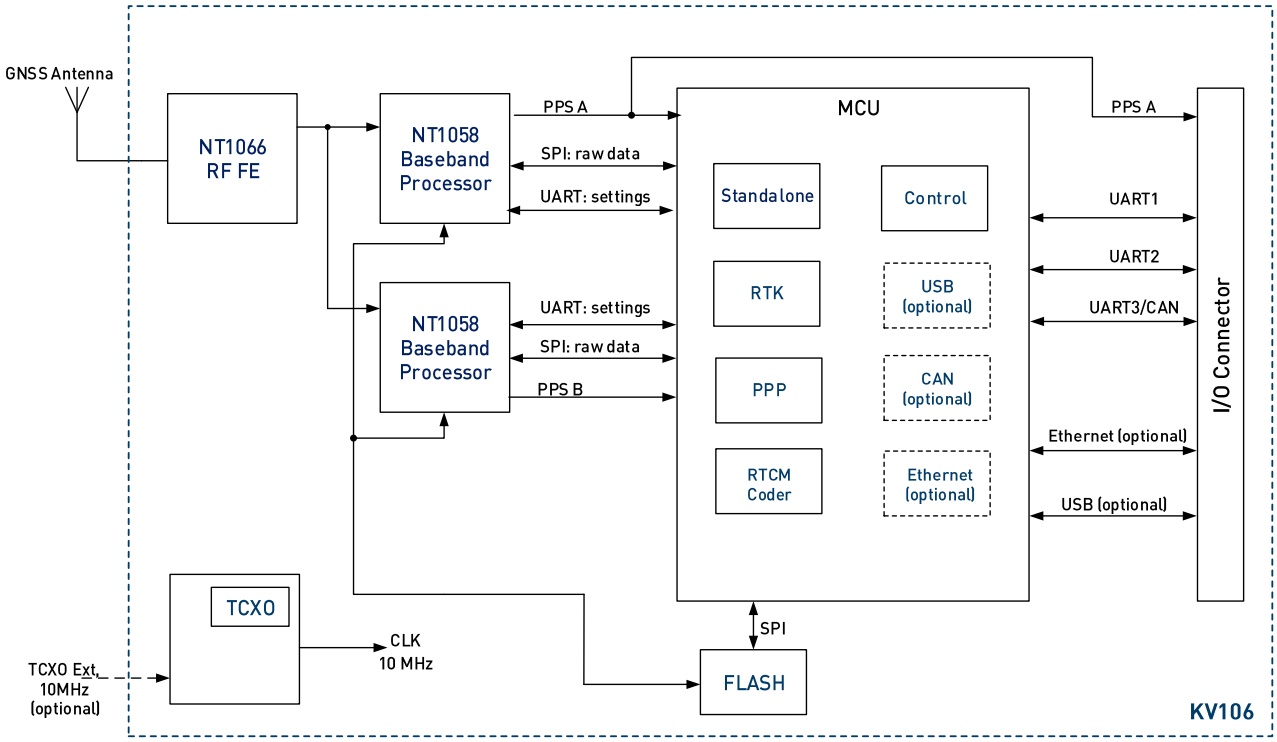

Figure 3.1– **KV106** Block Diagram

Notice:

- an active GNSS antenna is mandatory for the **KV106**;
- the **KV106** has two power supply pins: one pin for module power supply, another pin for antenna power supply;
- UARTs are used to transmit navigation information, to input/output RTCM correction, to monitor module status information, to configure and control the module;
- RF FE can be clocked from the internal TCXO (by default) or the external TCXO at 10 MHz (optional, on request).

4. SPECIFICATIONS

Table 4.1 – KV106 Specification

№	Parameter	Description	Note
1	Supported GNSS constellations	GPS L1 (C/A), L2 (CM)/L5 GLONASS L1 (C/A), L2 (C/A) Galileo E1, E5b/E5a NavIC L5, S-band BeiDou B1, B2 SBAS L1	- tracking user-selectable GNSS constellations - simultaneous using all GNSS in the navigation solution and raw measurements - EGNOS, GAGAN, WAAS, MSAS, SDCM - simultaneous use of two frequency bands for each GNSS constellations
2	Channels	256	
3	Time to First Fix (TTFF):		
	«Cold» Start	< 60 seconds	
	Signal Re-acquisition	< 2 seconds	
4	Positioning modes	standalone	simultaneous using of all GNSS
		PPP	Using GPS L1, L2, GLONASS L1, L2, Galileo E1, E5b/E5a; RTCM SSR; Ready for NavIC and BeiDou (subject of PPP corrections availability)
		RTK	simultaneous using of all GNSS; RTCM 3.4
5	Operation modes	RTK ROVER	RTCM 3.4
		RTK BASE	RTCM 3.4
6	Operation conditions	static mode	static receiver, static base station
		kinematic mode	moving receiver, static base station
		Moving Base	moving receiver, moving base station
7	Data Output Formats	NMEA 2.3, NMEA 4.11	
		NTL Binary	
		RTCM SC-104 (ver.3.4)	MSM + Legacy messages
8	Data update rates:		
	Standalone mode	20 Hz	1, 2, 5, 10 Hz are available
	PPP mode	20 Hz	
	RTK mode	20 Hz	
	GNSS measurements	20 Hz	
9	Measurement precision (one sigma):		
	C/A pseudoranges	20 cm	smoothed pseudoranges
	L1, L2 carrier phase	0.8 mm	

Table continuation 4.1 – KV106 Specification

10	**Accuracy (RMS)**		
	Horizontal:		
	standalone mode	1.1 m	Depends on atmospheric conditions, satellite visibility and geometry, multipath conditions, GNSS antenna
	SBAS mode	0.6 m	
	PPP mode	0.05 m	
	RTK FIX mode	0.005 m + 0.5 ppm	
	velocity	0.02 m/s	
	Vertical:		
	standalone mode	1.8 m	Depends on atmospheric conditions, satellite visibility and geometry, multipath conditions, GNSS antenna
	SBAS mode	0.9 m	
	PPP mode	0.1 m	
	RTK FIX mode	0.008 m + 1.0 ppm	
	velocity	0.03 m/s	
11	**Timing Accuracy**	+/- 20 ns	The PPS adjusts to the GPS/Glonass/Galileo/NavIC/BeiDou systems time with an accuracy of +/-20 ns (Glonass by default). It is possible to additionally shift the PPS edge along the time axis to the left/right (calibration). Voltage logic level is 2.5 V, pulse width is 1 ms. PPS is triggered by the leading edge.
12	**Interfaces**	3xUART, 1xPPSout	
13	**Maximum operating limits**		
	velocity	515 m/s	Option: 2000 m/s, 70000 m, 36 g Option is export controlled. Contact us for more information.
	altitude	18000 m	
	acceleration	8 g	
14	**Operating voltage**	3.0 V ...5.5 V	
15	**Power consumption**	up to 2.8 W	
16	**Dimensions (L × W × H)**	71 mm × 46 mm × 12.8 mm	
17	**Weight**	< 25 g	
18	**Operating temperature**	–40 °C ... +71 °C	
19	**Storage temperature**	–55 °C ... +85 °C	
Note: All specifications are at an ambient temperature of 25 °C			

5. COMMUNICATION PORTS AND PIN DEFINITION

Table 5.1 – I/O connector XP2 pin definitions

Pin No	Name	I/O	Description
1	USB_ID	Input	MCU USB FS[2]
2	USB_VBUS	Input	MCU USB FS[2]
3	BOOT	Input	MCU boot mode selection[2]
4	TPO-MID	Output	MCU ETHERNET[2]
5	LNA_PWR	Power	Antenna power supply
6	Power	Power	KV106 power supply voltage
7	USB_D-	I/O	MCU USB FS[2]
8	USB_D+	I/O	MCU USB FS[2]
9	GRESET	Input	Reset control (active-GND)
10	MF01[1]	I/O	MCU GPIO
11	MF02[1]	I/O	MCU GPIO
12	D3/CAN_Rx	Input	UART Rx line[3] or CAN[2] Rx line (CMOS_3.0)
13	EVENT[1]	Input	MCU
14,17,20,22	GND	Power	Signal and Power Ground
15	TXD1	Output	UART Tx line[3] (CMOS_3.0)
16	RXD1	Input	UART Rx line[3] (CMOS_3.0)
18	TXD2	Output	UART Tx line[3] (CMOS_3.0)
19	RXD2	Input	UART Rx line[3] (CMOS_3.0)
21	PV	Output	«Position Valid» indicator (CMOS_3.0)
23	PPS	Output	PPS time mark[4] (CMOS_2.5)
24	D3/CAN_Tx	Output	UART Tx line[3] or CAN[2] Tx line (CMOS_3.0)
25	TPO+	Output	MCU Ethernet[2]
26	TPI+	Input	MCU Ethernet[2]
27	TPO-	Output	MCU Ethernet[2]
28	TPI-	Input	MCU Ethernet[2]

Notes:

1 - Signals implemented in hardware for compatibility with Trimble and Novatel receivers, having the same form factor; not supported in actual firmware.

2 – It is hardware ready; basic firmware doesn't provide such options; may be developed on demand.

3 – *Digital inputs/outputs*:

V_{IL} : 0.3 V_{DD} (max); V_{IH} : 0.7 V_{DD} (min); V_{IH} : 3.0 V (max); V_{DD}=2.9 V;

V_{OL} : 0.3 V_{DD} (max); V_{OH} : 0.7 V_{DD} (min); V_{OH} : 3.0 V (max); V_{DD}=2.9 V.

4 – *Digital inputs/outputs*:

V_{IL} : 0.7 V (max); V_{IH} : 1.75 V (min); V_{IH} : 2.5 V (max);

V_{OL} : 0.7 V (max); V_{OH} : 1.75 V (min); V_{OH} : 2.5 V (max).

Table 5.2 – Basic configuration of **KV106** UART channels

Pin No	Name	Description
15	UART1 Tx	Available data formats: • NMEA-0183 or NTL Binary for nav. data transmission and control; • NovAtel OEM, RTCM3.4 (MSM + Legacy messages) for raw ranging data transmission; Baud rate: 9600...460800; Default settings: 460800 Baud, 8 bits, no parity bit, 1 stop bit, no data.
16	UART1 Rx	Available data formats: • RTCM3.4 Base station data input or RTCM-SSR messages; • NTL Binary for settings control; Baud rate: 9600...460800. Default settings: 460800 Baud, 8 bits, no parity bit, 1 stop bit, NTL Binary
18	UART2 Tx	Available data formats: • NTL Binary for nav. data transmission and control or NMEA-0183 for nav. data transmission; • NovAtel, RTCM3.4 (MSM + Legacy messages) for raw ranging data transmission; Baud rate: 9600...460800; Default settings: 460800 Baud, 8 bits, no parity bit, 1 stop bit, NTL Binary.
19	UART2 Rx	Available data formats: • NTL Binary for settings control; Baud rate: 9600...460800. Default settings: 460800 Baud, 8 bits, no parity bit, 1 stop bit, NTL Binary.
24	UART3 Tx	Available data formats: • NMEA-0183 or NTL Binary for nav. data transmission and control; • NovAtel OEM, RTCM3.4 (MSM + Legacy messages) for raw ranging data transmission; Baud rate: 9600...460800; Default settings: 460800 Baud, 8 bits, no parity bit, 1 stop bit, no data.
12	UART3 Rx	Available data formats: • RTCM3.4 Base station data input or RTCM-SSR messages; • NTL Binary for settings control; Baud rate: 9600...460800. Default settings: 460800 Baud, 8 bits, no parity bit, 1 stop bit, NTL Binary.
Note: NovAtel OEM 6: only messages for transmitting range measurements and ephemeris		

6. BOARD LAYOUT AND DIMENSIONS

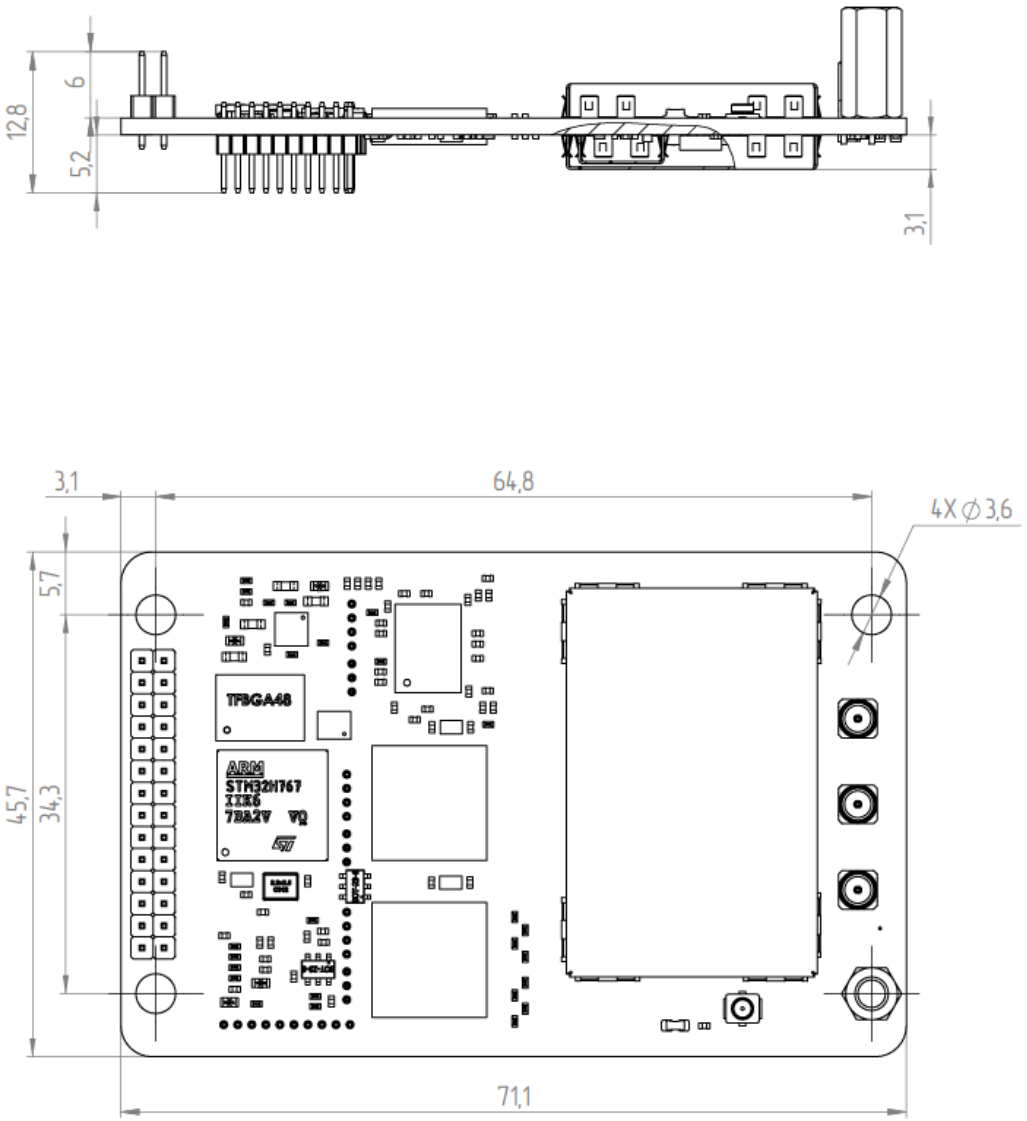

Figure 6.1 – KV106 Board Layout and Dimensions

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