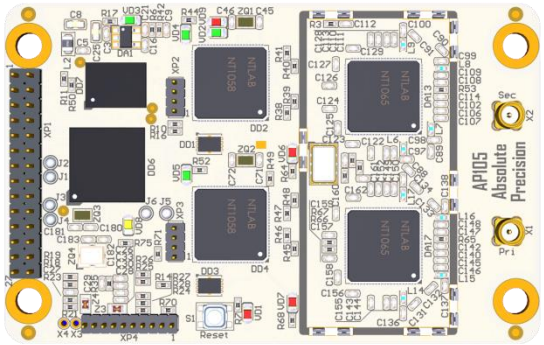
NTL105

OEM GNSS RECEIVER MODULE

Datasheet



2021

CONTENTS

1 NTL105 TECHNICAL DOCUMENTS

The complete information about **NTL105** OEM GNSS receiver module includes:

- **Actual datasheet**. It contains information about the **NTL105** structure, its basic features, technical specifications, interfaces, pin definitions, etc. It gives some utilization aspects specific for particular receiver structure.
- **GNSS-PPU-SETUP-GUIDE-AA-BB-CC.pdf**. It describes the concept of PPU (Primary Processing Unit), the basic object of the NTLab GNSS receivers. Then **NTL105** structure will be described in terms of PPU. It contains detailed information about operational aspects of GNSS receivers which have AA-BB version of embedded firmware (CC – revision of the document). Refer to this document to get information about available operational modes, control parameters, some internal logic aspects and interface commands which are used to control the receiver performance.
- **GNSS-DCP-BUILD-AA-BB-CC.pdf**. It contains information about Data Communication Protocols from the firmware version AA-BB. It describes how to parse data coming from **NTL105**, how to construct control commands and how to use the receiver in the most optimal way.
- **NTL105-BROWSER-GIUDE-CC.pdf**. It contains a quick guide for NTL Browser software tool designed by NTLab. It is a Windows 7/10 utility. It is used to visualize data coming from the receiver, to control receiver configuration, to update firmware. It is useful to a "fast start" with GNSS receiver.
- **NTL10X-EVA BOARD-MANUAL-CC.pdf**. It contains information about interface and power adapter which can be used to connect the **NTL105** to peripheral devices (PC), as well as to verify various module operation mode.

Documents can be revised by NTLab at any time. Visit **www.ntlab.lt** for the latest version of the documents.

2 NTL105 FUNCTIONAL DIAGRAM AND OPERATIONAL ASPECTS

NTL105 consists of three functional blocks:

- Master PPU;
- Slave PPU;
- RTK-Engine.

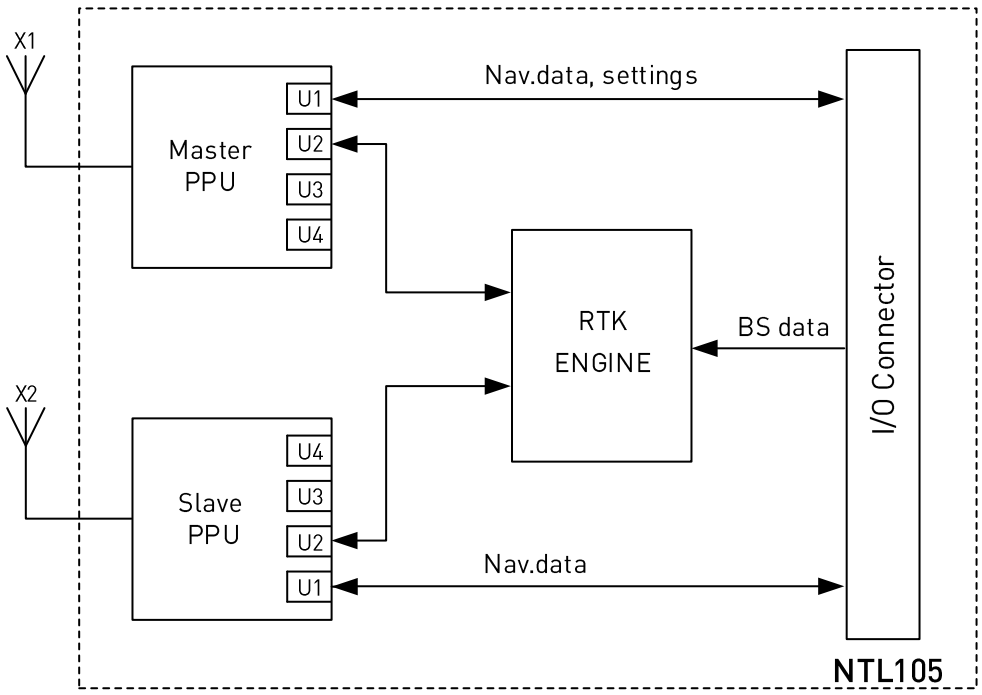


Figure 2.1 – **NTL105** functional diagram

PPU – Primary Processing Unit – is a basic functional block of OEM GNSS module. The definition of PPU is given in «GNSS-PPU-SETUP-GUIDE-AA-BB-CC.pdf» document. It is a set of hardware and firmware means required to process GNSS signals achieved from one antenna. It is a simple GNSS module with a standalone positioning mode. There are more sophisticated positioning modes available in combination with an additional PPU (Slave PPU) and an RTK Engine.

Purpose of functional blocks:

- Master PPU provides basic functionality of **NTL105**:

- computation of coordinates and velocity in standalone and SBAS modes;
- computation of precise time and generation of Pulse Per Second (PPS) strobes;
- generation of raw ranging data, based on code and carrier phase measurements.

Due to Slave PPU and RTK-Engine, Master PPU gains its functionality:

- computation of coordinates in differential modes (RTK-FIX, RTK-FLOAT, RTK-CDDIFF), in static and moving-base modes;
- heading + pitch determination.

- *RTK-Engine* is a kind of coprocessor. It provides additional computations for differential positioning. It allows computation of two differential vectors with the rate up to 10 Hz. Differential vector is a vector which connects the phase centers of two antennas.

In **NTL105** basic architecture the first vector connects Master and Slave antennas. If the vector components are computed it is possible to determine heading and pitch of antenna system.

The second vector connects Master and Base station (BS) antennas. Base station is a reference receiver whose precise coordinates are known. The base station data should be provided to implement this mode an access. High accuracy position of Master antenna is available when this vector is determined.

- *Slave PPU* provides RTK-Engine with raw ranging measurements made on Slave antenna signals. Even though, it is a full-function PPU having the same basic features as Master PPU. Coordinates of Slave antenna, that were achieved in standalone mode, are mostly out of interest for final user, but raw ranging measurements may be a point of interest. One of Slave PPU UART is available on I/O connector to give access to this data. RTK and Heading modes are not available for Slave PPU.

The final user should deal with Master PPU to gain RTK and Heading data. Refer to « GNSS-DCP-BUILD-AA-BB-CC.pdf » to get detailed information about its modes, control parameters, etc.

NOTES:

- *Commutation*

Each PPU has four physical UART modules. Only two of them are active – UART1 and UART2. Both Master UART2 and Slave UART2 is used for internal purpose – interaction with RTK-Engine. While RTK and/or Heading function is on, it is not available for NTL Binary or for raw data flow transmission. For Master PPU and Slave PPU UART1 is brought out onto I/O connector and it is the only physical channel to communicate with PPU.

One more UART available channel on I/O connector is used to receive base station data and connected directly to RTK-Engine module. Use BMT_CONFIG.UART4_CTRL command to setup bitrate of the port.

- *Control*

Master and Slave PPU are full-functional modules. They have independent sets of control parameters. Their settings should be kept in compliance while they work in pair. This is special necessary when **NTL105** works in Heading, RTK+ Heading modes. Control parameters from Master PPU are transferred to Slave PPU via special data channel in RTK-Engine. As a result, there is no need in any additional actions to set up Slave PPU. Refer to Master PPU controls to make settings and Slave PPU will stay in compliance automatically. Interface settings are the only block of control parameters which are not shared. As far as Slave is still available for access via separate UART, nothing should interfere with such communication.

Two more options are available for **NTL105**: *DUAL-RTK* and *OPEN-PLATFORM*, besides basic configuration.

DUAL-RTK is a configuration where RTK mode is available for both PPU, which are absolutely equal and independent. Heading function is not available. Such configuration may be used as a part of 3D orientation system. Instead of static base station, an additional reference receiver (e.g. AP101) may be used for raw data generation. Supplied with such measurements, **NTL105** may compute two RTK vectors in moving-base mode. Information about precise relative positions of three antennas may be used further to determine 3D orientation of the object they are installed on.

OPEN-PLATFORM is a configuration for customers who are interested in implementation of own post processing algorithms. Such configuration is provided without embedded firmware RTK functionality. MCU is available for programming and debugging. Both PPUs can be used as sources of raw ranging measurements and other information which is required for implementation of positioning algorithms. Measurements are based at all available civil GNSS signals at the moment. If you are interested in it, please, refer to NTLab company.

3 MODULE STRUCTURE, TOP VIEW AND INDICATION

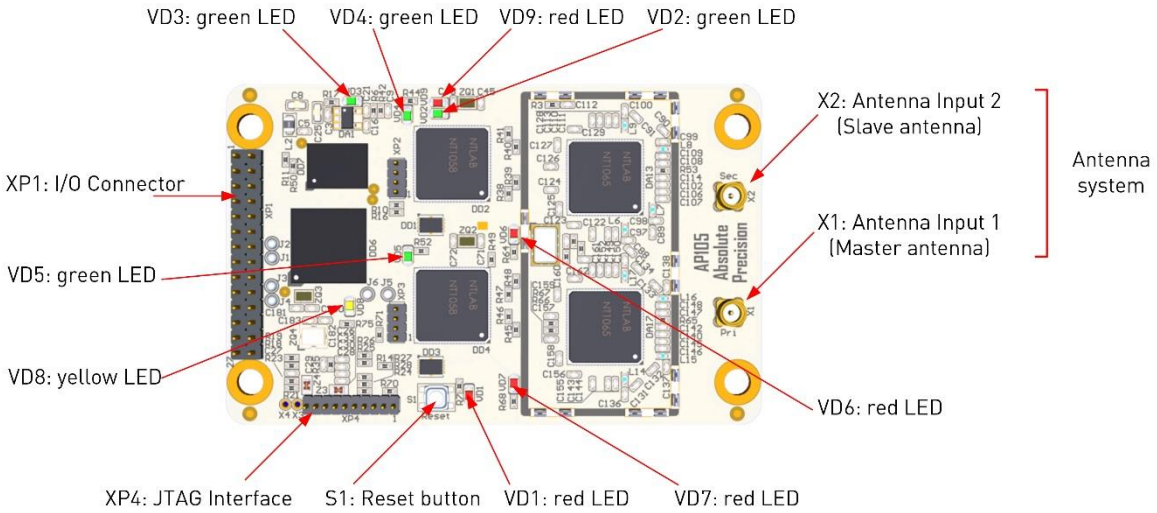


Figure 3.1 – **NTL105** top view

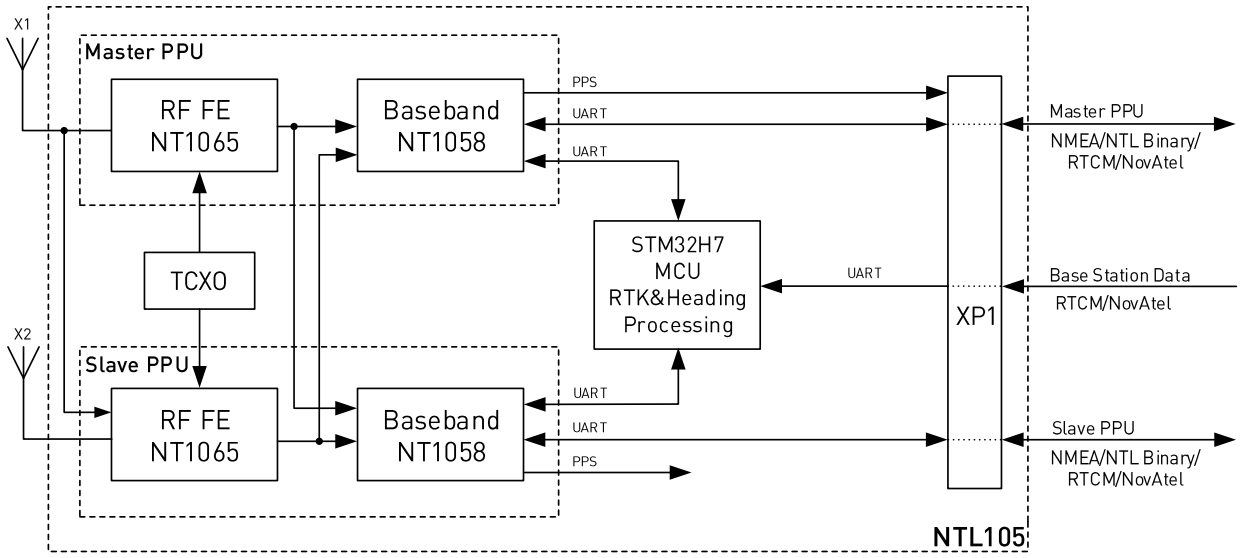


Figure 3.2 – **NTL105** structural diagram

Both PPUs have equal hardware platform. They are implemented on chips set which are designed by NTLab company:

- NT1065 is a 4-channel L1, L2, L5 band Radio-Frequency Front-End (RF FE) for GNSS signals reception: for amplification, filtering and down converting of the received signals to a fixed intermediate frequency (IF);
- NT1058 is a digital baseband processor having 64 dual channels for GNSS signals acquisition and tracking.

RTK-Engine is based on STM32H7 MCU having 400 MHz system clock and double word FPU coprocessor.

Connectors:

- X1, X2 are the MMCX type connectors for external active antennas[1] commutation. Central pin provides DC voltage for antenna power supply. DC voltage is wired from Pin 5 of I/O Connector XP1. It means that a **NTL105** host-device must provide DC voltage in accordance with active antenna requirements.
- XP1 is a PLD2-28 connector. Form factor of the board and XP1 pin-out is compatible with popular GNSS receiver families (Novatel 6xx, Trimble and others). Refer to Chapter 5 for XP1 pinout, refer to Chapter 6 for PCB dimensions.
- XP4 is a PLS-10 connector for STM MCU debugging and programming with JTAG.

LEDs:

- Red LED VD1 is indicator of the Reset control.
- Green LED VD2 is indicator of the antenna power supply (Green Solid).
- Green LED VD3 is indicator of the 3.3V DC voltage for the module power supply (Green Solid).
- Green LEDs VD4 and VD5 are the indicators of NT1058 normal performance in the PPU1 and the PPU2. It should blink once per second during normal operation (Green Blinking).
- Red LEDs VD6 and VD7 are the indicators of the RF FE normal operation. It is OFF during normal operation (No Light). If those LEDs are ON, please, check active antenna circuitry. This may indicate not appropriate level of amplification in active antenna: too low or too high.
- Yellow LED VD8 is indicator of the RTK-Engine normal operation (Yellow Solid).

---

[1] GNSS External Active Antenna Requirements:
- Antenna voltage supply 5V;
- Maximum current 100mA;
- LNA Gain Range (minus signal loss) 20...35dB.

- Red LED VD9 is indicator of the erroneous situation (backward current) in antenna power circuit. Should be OFF during normal operation (No Light).

So, nine user LED indicators (VD1…VD9) allow you to monitor the status of some nodes of the board: the board power status, the current operation status, malfunction. Green LEDs indicate correct operation. Red LEDs indicate a fault.

4 TECHNICAL PARAMETERS

Table 4.1 – Technical parameters

Supported GNSS signals												
PPU	GPS			GLO		GAL			BDO		IRN	
	L1	L2	L5	L1	L2	E1	E5b	E5a	B1	B2	L5	S
Master	+	+/- or -/+		+	+	+	+/- or -/+		+	+	+	-
Slave	+	+	-	+	+	+	-	-	+	-	-	-

Measurement Precision			
	Precision, RMS	Units	Notes
C/A pseudoranges	20	cm	Smoothed pseudoranges
L1, L2 carrier phase	0.8	mm	

Positioning modes and accuracy					
		Accuracy, RMS		Units	Notes
		Plane	Vertical		
Autonomous	Standalone	1.2	1.5	m	Depends on atmospheric conditions, satellite visibility and geometry, multipath conditions, GNSS antenna
	DGPS	0.4	0.6	m	GPS+SBAS
Differential	CDDIFF	1.0	1.5	m	Accuracy depends on the baseline length.
	FLOAT	0.5	0.75	m	
	FIX	5+0.5ppm	8+0.5ppm	mm	

2D orientation accuracy			
Heading	0.06	deg	Measured on 2 meters antenna baseline
Pitch	0.15	deg	

Data update rates				
Position, velocity, time	Standalone mode	1	Hz	no options
	Differential mode	10	Hz	1,5,10 Hz available
Heading, pitch		10	Hz	
Raw data		20	Hz	

Electro-mechanical characteristics				
Operating temperature, °C	-55 to +85		Storage temperature, °C	-40 to +80
Supply voltage, V	3.3 to 5.3		Power consumption, W	< 2
Dimensions (L x W x H), mm	71 x 46 x 10		All specifications are at an ambient temperature of 25 °C. Extreme operating temperatures can significantly impact specification values.	
Weight, g	< 45			

5 COMMUNICATION PORTS AND PIN DEFINITION

Table 5.1 – I/O connector XP1 pin definitions

Pin No	Name	I/O	Type	Description
1	USB_ID	Input	CMOS_3.3	STM32H7 MCU USB FS[2]
2	USB_VBUS	Input		STM32H7 MCU USB FS[2]
3	BOOT	Input		STM32H7 MCU boot mode selection[2]
4	TPO-MID	Output		STM32H7 MCU ETHERNET[2]
5	LNA_PWR	Power	Analog	Antenna power supply
6	Power	Power	Analog	**NTL105** power supply voltage
7	USB_D-	I/O	CMOS_3.3	STM32H7 MCU USB FS[2]
8	USB_D+	I/O		STM32H7 MCU USB FS[2]
9	GRESET	Input	CMOS_3.3	Reset control (active-low)
10	MF01[1]	I/O	CMOS_3.3	STM32H7 MCU GPIO
11	MF02[1]	I/O		STM32H7 MCU GPIO
12	RxD3/CANRx[3]	Input		UART3 Rx line (optionally Can Rx line)
13	EVENT[1]	Input		STM32H7 MCU
14,17,20,22	GND	Power	Analog	Signal and Power Ground
15	TXD1	Output	CMOS_2.5	Slave PPU UART Tx line (UART1 Tx line)
16	RXD1	Input		Slave PPU UART Rx line (UART1 Rx line)
18	TXD2	Output		Master PPU UART Tx line (UART2 Tx line)
19	RXD2	Input		Master PPU UART Rx line (UART2 Rx line)
21	PV	Output	CMOS_3.3	«Position Valid» indicator
23	PPS	Output	CMOS_2.5	PPS time mark (wired from Master PPU)
24	TxD3/CANTx[3]	Output	CMOS_3.3	UART3 Tx line (optionally Can Tx line)
25	TPO+	Output		STM32H7 MCU Ethernet[2]
26	TPI+	Input		STM32H7 MCU Ethernet[2]
27	TPO-	Output		STM32H7 MCU Ethernet[2]
28	TPI-	Input		STM32H7 MCU Ethernet[2]
Notes	1- Signals are implemented in hardware for compatibility with Trimble and Novatel receivers, which have 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- UART3 TX/RX by default; CAN may be implemented on demand.			

Table 5.2 – Basic configuration of **NTL105** UART channels

Pin No	Name	Description
18	UART2 Tx	It provides access to Master PPU UART1 (UART1 in terms of PPU-SETUP-GUIDE). Available data transmission formats: • NMEA-0183 or NTL Binary for nav. data transmission and control; • RTCM3.3 (MSM + Legacy messages) or Novatel OEMv7 for raw ranging measurements transmission. Available baud rate diapason: 9600 to 460800. *Default settings*: 115200 Baud, 8 bits, no parity bit, 1 stop bit, NTL Binary.
19	UART2 Rx	
15	UART1 Tx	It provides access to Slave PPU UART1 (UART1 in terms of PPU-SETUP-GUIDE). Available data transmission formats: • NMEA-0183 or NTL Binary for nav. data transmission and control; • RTCM3.3 (MSM + Legacy messages) or Novatel OEMv7 for raw ranging measurements transmission. Available baud rate diapason: 9600 to 460800. *Default settings*: 115200 Baud, 8 bits, no parity bit, 1 stop bit, NTL Binary.
16	UART1 Rx	
12	UART3 Rx	Base station data input. Available data formats: • RTCM3.1; • Novatel OEMv7 messages. Available baud rate diapason: 9600 to 460800. *Default settings*: 115200 Baud, 8 bits, no parity bit, 1 stop bit, RTCM3.1.
24	UART3 Tx	Not used
Refer to «GNSS-DCP-BUILD-AA-BB-CC.pdf» document to get more information about interface performance details.		

In OPEN-PLATFORM version definition of UART1, UART2 and UART3 data channels can be different. Up to three STM32H7 UART modules can be commutated to XP1 connector as well as some GPIO signals and other peripherals. If you are interested in OPEN-PLATFORM version, please, refer to NTLab company for extended version of **NTL105** datasheet.

6 BOARD LAYOUT AND DIMENSIONS

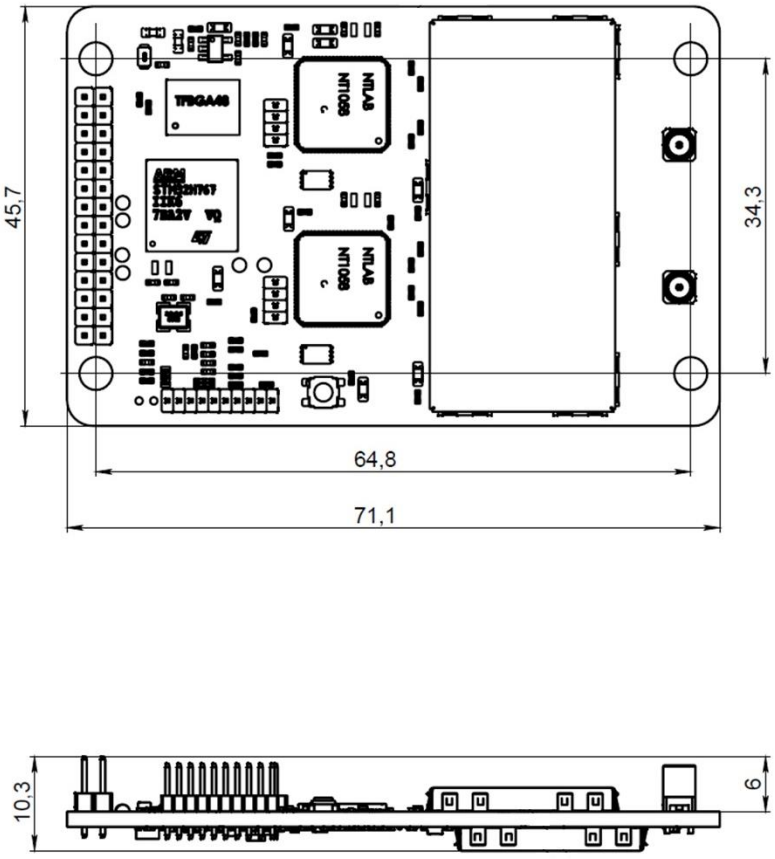


Figure 6.1 – **NTL105** Board Layout and Dimensions

CONTACTS

For complete contact information visit us at **www.ntlab.lt**

Head Office
4th floor, 41 Surganova str., 220013 Minsk, Republic of Belarus
Tel.: +375 17 290 09 99
Fax: +375 17 290 98 98
e-mail: ntlab@ntlab.com, sales@ntlab.com

EU Branch Office
NTLAB, UAB
Švenčionių g. 112, Nemenčinė, LT-15168 Vilniaus r., Lithuania
Tel.: +370 6 169 5418
e-mail: sales@ntlab.lt