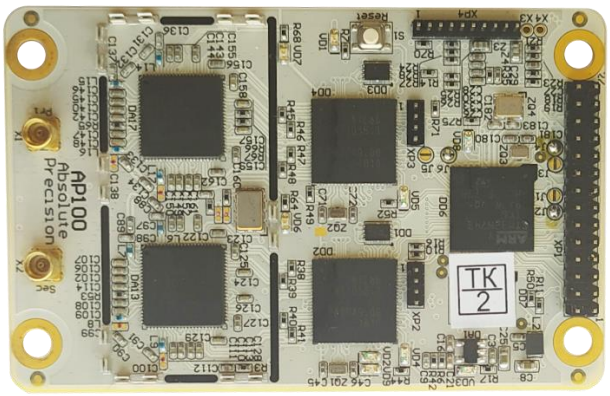
NTL106

GNSS OEM RECEIVER MODULE

Datasheet



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CONTENTS

1 NTL106 TECHNICAL DOCUMENTS

The complete information about NTL106 GNSS receiver includes:

- **Actual datasheet.** Contains information about particular GNSS receiver structure, basic features, electrical specification, pin definitions, etc. Highlights some utilization aspects specific for a 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 NTL106 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 NTL106, how to construct control commands and how to use the receiver in the most optimal way.
- **NTL-BROWSER-GIUDE-CC.pdf**. It contains a quick guide for NTL_Browser application. 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-ADP BOARD-MANUAL-CC.pdf**. It contains information about interface adapter which can be used with OEM GNSS receivers to implement of "fast start" and to connect them to PC.

2 NTL106 FUNCTIONAL DIAGRAM AND OPERATIONAL ASPECTS

The NTL106 OEM module is a single-antenna multi-band GNSS receiver that can be used for the following purposes:

- as a source of navigational data (Position, Velocity, Time) in autonomous mode (standalone mode, DGPS), 1Hz;
- as a source of navigational data (Position, Velocity, Time) in RTK mode (a source of Base Station measurements is required), 10Hz;
- as a source of raw ranging measurements (include pseudoranges, measured by code and carrier phase), 20Hz;

NTL106 consists of three functional blocks:

- PPU1;
- PPU2;
- RTK-Engine.

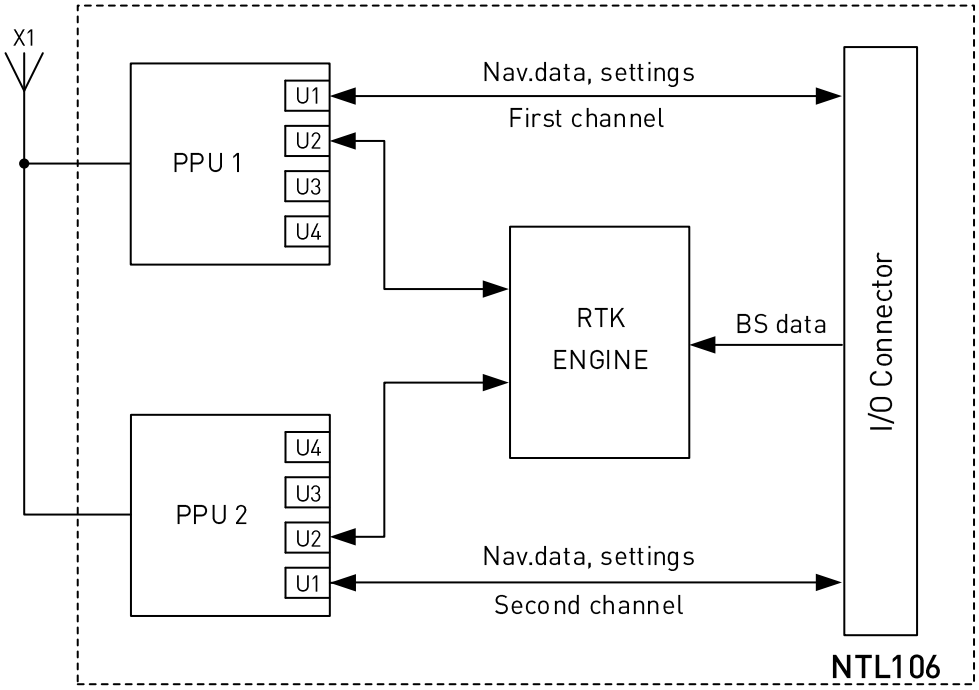

Figure 2.1 – NTL106 functional diagram

PPU is a basic functional block of GNSS receiver. The definition of PPU is given in «GNSS-PPU-SETUP-GUIDE-AA-BB-CC.pdf» document. It is a simple GNSS receiver with an autonomous positioning mode.

NTL106 contains two PPUs, which have different system settings. By default, the PPU1 and the PPU2 is configured as follows:

- PPU1 tracks GPS, GLONASS and NavIC signals (including SBAS);
- PPU2 tracks Galileo and BeiDou signals (including SBAS).

It allows to receive and to process the maximum number of various navigation systems satellites. As result, the maximum number of raw ranging measurements can be formed. It is enough to combine raw ranging measurements from two independent channels (first channel and second channel) by the utility which is designed by the NTLab company, for the next post-processing of the data. The utility combines two RTCM MSM data streams into one stream. Data sources can be files, COM ports, or TCP/IP ports. The receiver of data can also be a file, COM port or TCP/IP port.

There are more sophisticated positioning modes available in combination with PPU1, PPU2 and RTK Engine.

Purpose of functional blocks:

- *PPU1* provides next functionality of GNSS receiver:

- computation of position and velocity in standalone and DGPS (+SBAS) modes;
- computation of precise time and generation of Pulse Per Second strobes;
- generation of raw ranging measurements, based on code and carrier phase measurements.
- computation of coordinates in differential modes (RTK-FIX, RTK-FLOAT, RTK-CDDIFF), in static and moving-base modes (due to PPU2 and RTK-Engine);

- *RTK-Engine* is a kind of coprocessor. It provides additional computations for differential positioning. It allows computation of the differential vector with the rate up to 10Hz. Differential vector is a vector which connects the phase centers of two antennas (NTL106 antenna and Base Station (BS) antenna). Base station is reference receiver whose precise coordinates are known. The base station data must be provided to implement this mode. High accuracy position of NTL106 antenna is available when this vector is determined.

- *PPU2* provides next functionality of GNSS receiver:

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

Its purpose in NTL106 architecture is to provide RTK-Engine additional raw ranging measurements. It is not recommended to configure PPU2 for RTK mode, although it is a full-function PPU with the same basic features as PPU1.

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.

In PPU1 and PPU2, UART2 is used for internal purpose – interaction with RTK-Engine. It is not available for NTL Binary or raw ranging measurements transmission while RTK function is on.

In PPU1 and PPU2, UART1 is brought out to the I/O connector pins. It is the only physical channel to communicate with PPU.

One more UART channel available on the 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 that port.

One more option is available for NTL106, besides basic configuration. It is OPEN-PLATFORM.

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

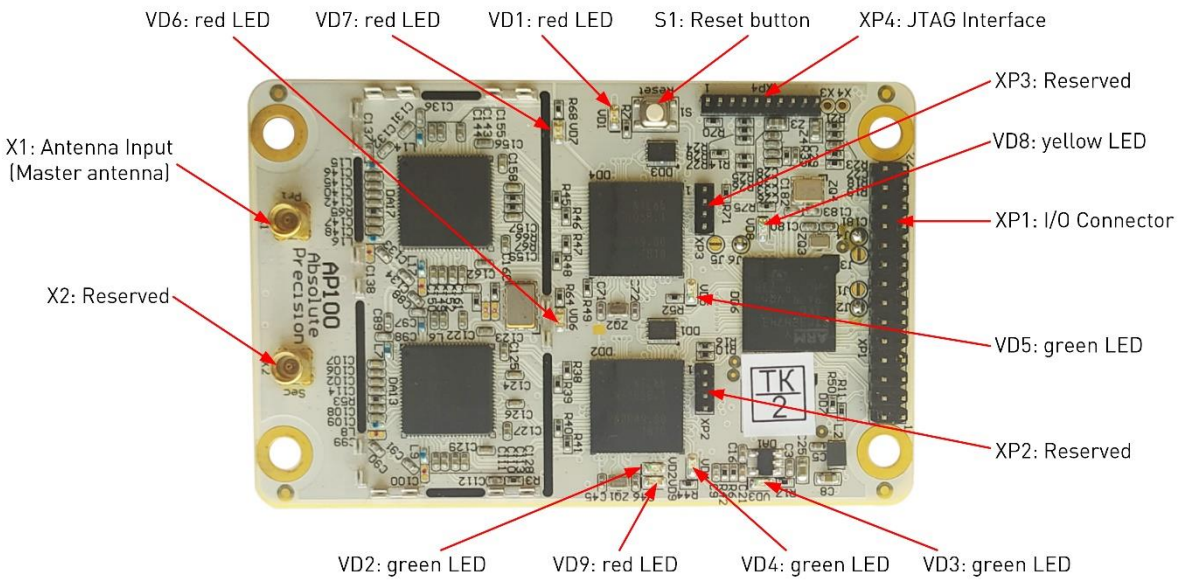

Figure 3.1 – NTL106 top view

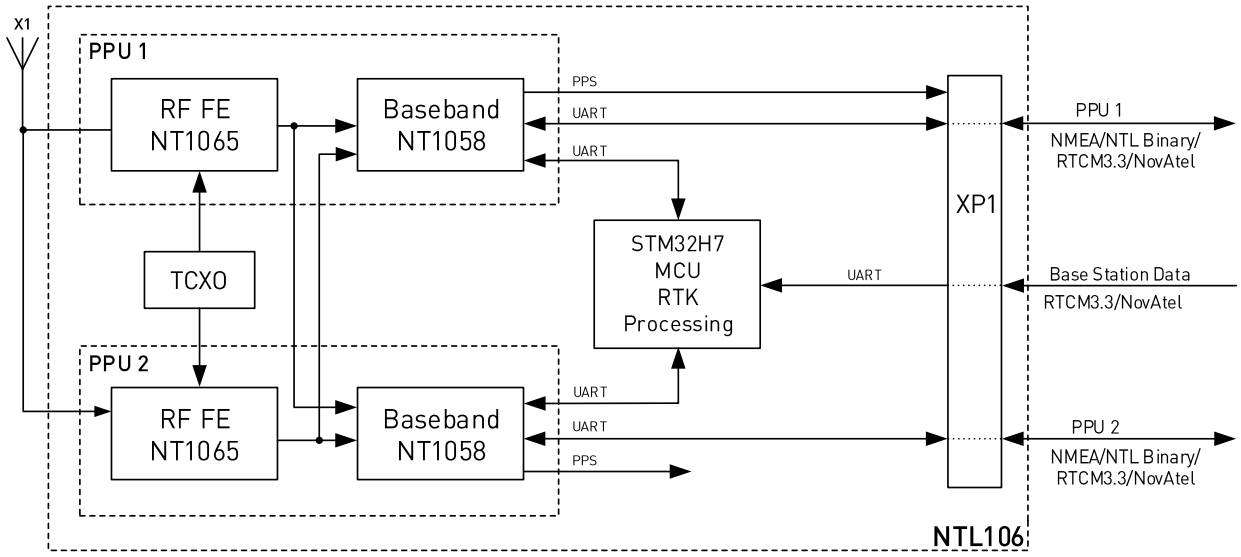

Figure 3.2 – NTL106 structural diagram

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 integrated circuit for GNSS signals reception;
- 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 – MMCX type connector for external active antenna[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 NTL106 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 Section 5 for XP1 pinout, refer to Section 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 DC voltage 3.3V (Green Solid).
- Green LEDs VD4 and VD5 are the indicators of normal performance of the PPU1 and the PPU2. It must blink once per second during normal operation (Green Blinking).
- Red LEDs VD6 and VD7 are the indicators of the RF FE normal operation. Should be OFF during normal operation (No Light).

  If those LEDs are ON, please, check active antenna circuitry. That 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).
- 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.

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

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
PPU1	+	+/- or -/+		+	+	+	+/- or -/+		+	+	+	-
PPU2	+	+/- or -/+		+	+	+	+/- or -/+		+	+	+	-

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	1.5	2.1	m	Depends on atmospheric conditions, satellite visibility and geometry, multipath conditions, GNSS antenna
	DGPS	0.8	1.1	m	GPS+SBAS
Differential	CDDIFF	0.6	0.85	m	Depends on the baseline length.
	FLOAT	0.5	0.75	m	
	FIX	5+0.5ppm	8+1.0ppm	mm	

Data update rates				
Position, velocity, time	Standalone mode	1	Hz	no options
	Differential mode	10	Hz	1,2,5 Hz available
Raw data		20	Hz	1,2,5,10 Hz available

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	<1.8
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	MCU STM32H7 USB FS[2]
2	USB_VBUS	Input		MCU STM32H7 USB FS[2]
3	BOOT	Input		MCU STM32H7 boot mode selection
4	TPO-MID	Output		MCU STM32 ETHERNET[2]
5	LNA_PWR	Power	Analogue	Antenna power supply voltage
6	Power	Power	Analogue	NTL106 power supply voltage
7	USB_D-	I/O	CMOS_3.3	MCU STM32H7 USB FS[2]
8	USB_D+	I/O		MCU STM32H7 USB FS[2]
9	GRESET	Input	CMOS_3.3	Reset control (active-low)
10	MF01[1]	I/O	CMOS_3.3	MCU STM32H7 GPIO
11	MF02[1]	I/O		MCU STM32H7 GPIO
12	RxD3/CANRx[3]	Input		UART3 Rx line (optionally Can Rx line)
13	EVENT[1]	Input		MCU STM32H7
14,17,20,22	GND	Power	Analogue	Signal and Power Ground
15	TXD1	Output	CMOS_2.5	PPU2 UART Tx line (UART1 Tx line)
16	RXD1	Input		PPU2 UART Rx line (UART1 Rx line)
18	TXD2	Output		PPU1 UART Tx line (UART2 Tx line)
19	RXD2	Input		PPU1 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 PPU1)
24	TxD3/CANTx[3]	Output	CMOS_3.3	UART3 Tx line (optionally Can Tx line)
25	TPO+	Output		MCU STM32H7 Ethernet[2]
26	TPI+	Input		MCU STM32H7 Ethernet[2]
27	TPO-	Output		MCU STM32H7 Ethernet[2]
28	TPI-	Input		MCU STM32H7 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– NTL106 hardware is ready to support marked interfaces; 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 NTL106 UART channels

<table>
<tr><th>Pin No</th><th>Name</th><th>Description</th></tr>
<tr><td>18</td><td>UART2 Tx</td><td rowspan="2">It provides access to PPU1 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.</td></tr>
<tr><td>19</td><td>UART2 Rx</td></tr>
<tr><td>15</td><td>UART1 Tx</td><td rowspan="2">It provides access to PPU2 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.</td></tr>
<tr><td>16</td><td>UART1 Rx</td></tr>
<tr><td>12</td><td>UART3 Rx</td><td>Base station data input. Available data formats:
• RTCM3.3 (MSM+Legacy messages);
• Novatel OEMv7 messages.
Available baud rate diapason: 9600 to 460800.
Default settings: 115200 Baud, 8 bits, no parity bit, 1 stop bit, RTCM3.3.</td></tr>
<tr><td>24</td><td>UART3 Tx</td><td>Not used</td></tr>
<tr><td colspan="3">Refer to «GNSS-DCP-BUILD-AA-BB-CC.pdf» document to get more information about interface performance details.</td></tr>
</table>

In OPEN-PLATFORM version definition of UART1, UART2 and UART3 data channels can be different. Up to three STM32H7 UART modules can be routed to XP1 connector as well as some GPIO signals and other peripherals. If you are interested in OPEN-PLATFORM version, please, refer directly to NTLab company for extended version of NTL106 datasheet.

6 BOARD LAYOUT AND DIMENSIONS

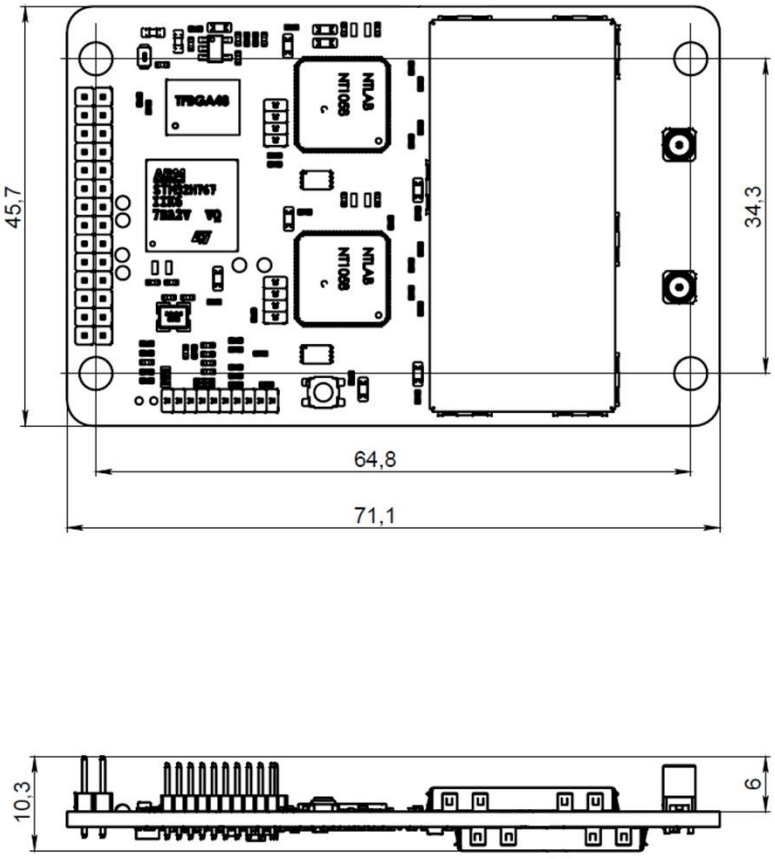

Figure 6.1 – NTL106 Board Layout and Dimensions

CONTACTS

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