GNSS Receiver Module ICB-88156

USER MANUAL

Content

1 Purpose

The ICB-88156 receiver module (hereinafter referred to as the module) is a cost-effective global navigation satellite system (GNSS) positioning module that supports GPS/QZSS, BDS, Galileo, GLONASS and SBAS with low current consumption.

This universal module includes an LNA (low-noise amplifier), SAW (surface acoustic wave filter), flash memory, and an antenna control unit. It can be used with active and passive antennas. It is suitable for a wide range of tracking, telematics, and navigation applications.

2 Peculiarities

- Universal GNSS module with support for GPS/QZSS, BDS, Galileo, GLONASS and SBAS
- Low current consumption (15 mA for GPS/QZSS)
- Support for active and passive antennas thanks to built-in SAW and LNA. The module

features are listed in Table 1.

Table 1 — Module Features

GNSS							Peculiarity					Interface	Accuracy	Class
GNSS mode	Range (S/D/T)	GPS/QZSS	BDS	GLONASS	Galileo	SBAS	Built-in LNA	Programmable (flash)	Data logging	D-GNSS	Generator	UART	Meter	Industrial
01	S	●	—	●	—	●	●	●	●	●	T	●	●	●
02	S	●	—	●	●	●	●	●	●	●	T	●	●	●
03	S	●	●	—	●	●	●	●	●	●	T	●	●	●
T – TCXO (temperature compensated quartz crystal oscillator)														

ATTENTION!

The GNSS mode is set by the module's factory firmware. By default, GNSS mode 01 is selected. If a different mode is required, please specify the desired GNSS mode when ordering.

3 Appearance

The external appearance of the module is shown in Figure 1.

Figure 1 – External appearance of the module.

4 Block diagram

The block diagram of the module is shown in Figure 2.

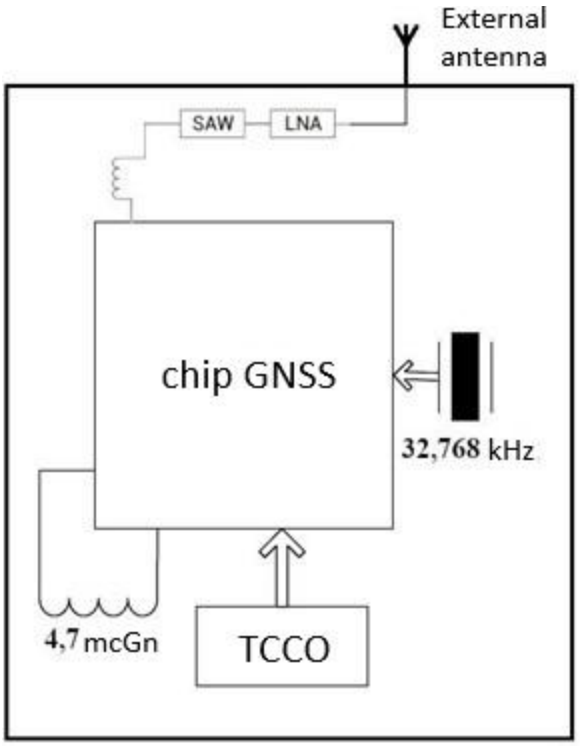

Figure 2 – Block diagram of the module.

5 Technical specifications

The technical characteristics of the module are given in Table 2. Table

2 - Technical characteristics of the module

Name of the characteristic	Meaning		
GNSS channels	88		
GNSS reception	GPS/QZSS: L1C/A		
	GLONASS: G1		
	Galileo: E1		
	BDS: B1I		
	SBAS: L1 (SDCM, WAAS, EGNOS, GAGAN and MSAS)		
Refresh rate	5 Hz maximum		
Position accuracy (open sky)	GNSS		1.5 m CEP
	GNSS (with SBAS)		< 1.0 m CEP
Speed and time accuracy	GNSS		0.1 m/s CEP
	1PPS		20 ns
Sensitivity (shown with good external LNA)	Cold start		-148 dBm
	Hot start		-156 dBm
	Recapture		-158 dBm
	Tracking		-163 dBm
Working condition	Main voltage		2.0–3.63 V
	Digital input/output voltage		2.0–3.63 V
	Backup voltage		1.8-3.63 V
Power consumption	Tracking	GPS/QZSS+Galileo+GLONASS+SBAS	20 mA, 3.3 V
		GPS/QZSS+GLONASS+SBAS	20 mA, 3.3 V
		GPS/QZSS+Galileo+BDS+SBAS	16 mA, 3.3 V

Name characteristics	Meaning		
	Capture	GPS/QZSS+Galileo+GLONASS+SBAS	20 mA, 3.3 V
		GPS/QZSS+GLONASS+SBAS	21 mA, 3.3 V
		GPS/QZSS+Galileo+BDS+SBAS	17 mA, 3.3 V
		GPS/QZSS	15 mA, 3.3 V
	Expectation	15 μA, 3.3 V	
Interface	UART	1	
Protocol	NMEA 0183 version 3.01/4.00/4.10 (default), Binary protocol		
Operating range	Speed		515 m/s
	Height		18,000 m
Antenna control	Antenna short-circuit protection and open-circuit detection		
Operating temperature	-40℃ to +85℃		
Temperature storage	-40℃ to +85℃		

The time to first commit (TTFF) of the module is given in Table 3. Table

3 - Time to first commit (TTFF)

Parameter, unit of measurement	GPS/QZSS+Galileo+ GLONASS+SBAS	GPS/QZSS+G LONASS+SBAS	GPS/QZSS+Galileo+ BDS+SBAS	GPS/QZSS
Hot start, with	2	2	2	1
Cold start, with	26	28	28	28

6 Description of the findings

The numbering and designation of the module terminals is shown in Figure 3.

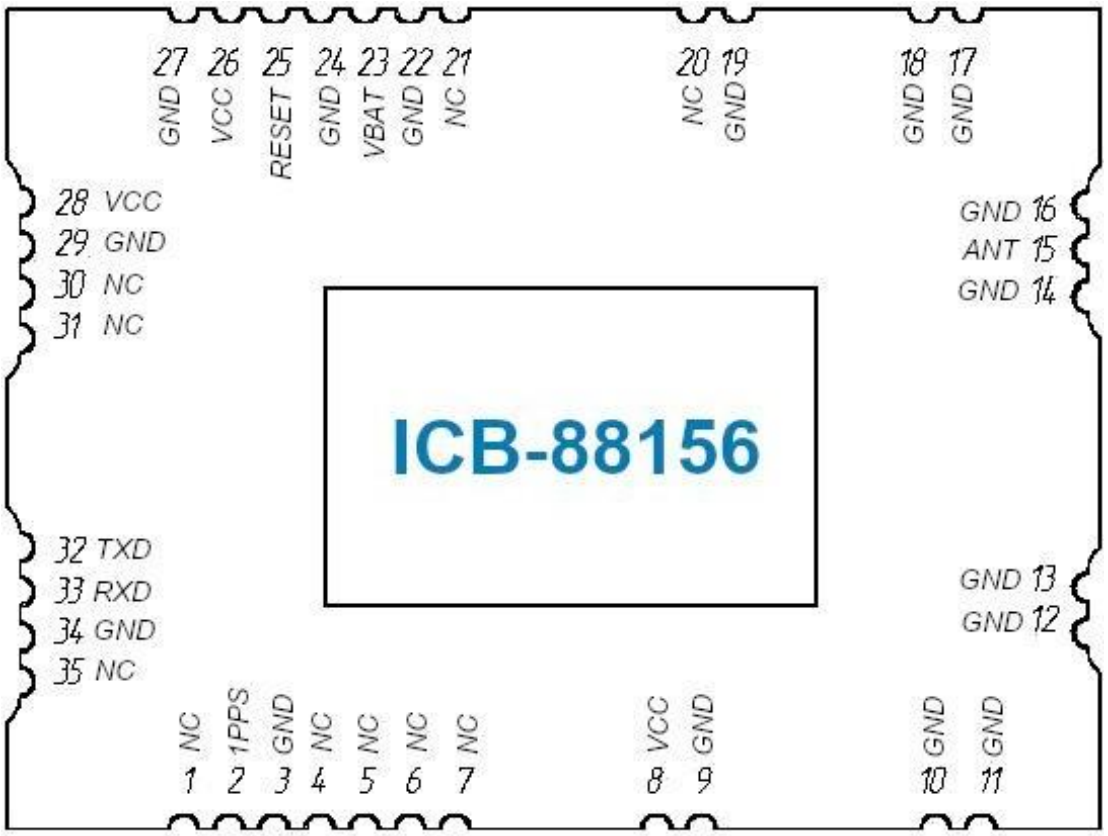

Figure 3 – Numbering and designation of module terminals.

The description of the module pins is given in Table 4.

Table4- Description of module pins

Function	Designation	Number	Entry/Exit	Description
Nutrition	VSS	8, 26, 28	Nutrition	Input voltage of the main power supply
	GND	3, 9-14, 16-19, 22, 24, 27, 29, 34	VSS	Ensure a good GND connection to all GND pins of the module, preferably with a large plate grounding
	VBAT	23	Nutrition	Input voltage backup power supply
Antenna	ANT1)	15	Entrance	RF signal input. Use a controlled impedance PCB with a layout that ensures 50 Ohm between the ANT terminal and the antenna or antenna connector.
UART	TXD	32	Exit	Output of sequential UART data.
	RXD	33	Entrance	Entering sequential UART data.
System	RESET	25	Entrance	External reset, active low level.
	1PPS	2	Exit	Pulse Time Output (PPS). Leave this unconnected if not in use.
Reserve	RESERVED/ NC	1, 4-7, 20, 21, 30, 31, 35	———	———
1) - The ANT output of the version 1 module is also used to power the external active antenna.				

ATTENTION!
The module can be supplied in one of the two versions listed below. Version 1 - the module supplies power to the active antenna with voltage

power supply specified in Table 8 of this operating manual. This design is intended for connecting an active antenna powered by the module.

Version 2 - The module does not provide power to the active antenna. This version is designed for connecting a passive antenna or an active antenna with a separate power supply.

When ordering a module, you must specify the module version.

7 Electrical characteristics

7.1 Limit values

The maximum values of the module parameters are given in Table 5.

Table 5 - Maximum values of the module parameters

Designation	Parameter, unit of measurement	Minimum parameter value	Maximum parameter value
VCC	Input voltage of the main power supply, V	- 0.5	3.63
VBAT	Input voltage of the backup power supply, V	- 0.5	3.63
VI_{max}	Digital input voltage input/output, V	- 0.5	3.6
$T_{storage}$	Storage temperature, °C	- 40	+ 85
T_{solder}	Solder reflow temperature, ° C, no more than	—	260
VESD (HBM)	Maximum allowable electrostatic discharge level, V	—	2000

7.2 Pin characteristics

The characteristics of the RESET pin are shown in Table 6.

Table 6 – Characteristics of the RESET pin

Designation	Parameter, unit measurements	Condition	Minimum value parameter	Maximum value parameter
I_{IZ}	Input leakage current, μA	—	—	+/- 1
V_{IH}	Input voltage high logic level, B	—	VBAT x 0.67	VBAT
V_{IL}	Input voltage logic low level, B	—	0	VBAT x 0.27

Designation	Parameter, unit measurements	Condition	Minimum value parameter	Maximum value parameter
V_{OH}	Weekend voltage high logicallevel, B	I_{OH} = 5.3 mA, VBAT = 3.3 V	2.64	—
		I_{OH} = 1.2 mA, VBAT = 1.8 V	1.53	—
V_{OL}	Weekend voltage low logic level, B	I_{OL} = 3.9 mA, VBAT = 3.3 V	—	0.4
		I_{OL} = 1.9 mA, VBAT = 1.8 V	—	0.45
C_i	Input capacitance, pF	—	—	11
R_{PU}	Pull-up resistance, kOhm	—	35	84

The characteristics of other module terminals are shown in Table 7.

Table 7 – Characteristics of other module terminals

Designation	Parameter, unit of measurement	Condition	Minimum parameter value	Maximum parameter value
I_{IZ}	Input leakage current, μA	—	—	+/- 1
V_{IH}	Input voltage high logic level, B	—	VCC x 0.67	VCC
V_{IL}	Input voltage low logic level, IN	—	0	VCC x 0.27
V_{OH}	Output voltage of high logic level, V	I_{OH} = 5.3 mA, VCC = 3.3 V	2.64	—
V_{OL}	Output voltage low logic level, B	I_{OL} = 3.9 mA, VCC = 3.3 V	—	0.4
C_i	Input capacitance, pF	—	—	11
R_{PU}	Pull-up resistance, kOhm	—	35	84

8 DC characteristics

8.1 Operating values of module parameters

The operating values of the module parameters are shown in table 8.

Table 8 – Operating values of the module parameters

Designation	Parameter, unit measurements	Minimum value parameter	Nominal value parameter	Maximum value parameter
VCC	Input voltage of the main power supply, IN	2.0	3.3	3.63
VBAT	Input voltage of backup power supply, IN	1.8	3.3	3.63
ISS_{max}	Maximum operating current at VCC, mA	—	—	200
T_{env}	Operating temperature, ° C	- 40	—	+85
$V_{ANT\_BIAS1)}$	Antenna supply voltage, V	—	VCC-0.15 (tested at high, low and room temperatures with deviation of 0.1 V)	—
1) – Only for execution module 1				

8.2 Power consumption

Power consumption is shown in Table 9.

Table 9 – Power consumption

Parameter		Measured output	Nominal value parameter	Unit of measurement
Tracking	GPS/QZSS+Galileo+GLONASS+SBAS	VCC (VCC = 3.3 V at room temperature. All outputs are disconnected.)	20	mA
	GPS/QZSS+GLONASS+SBAS		20	
	GPS/QZSS+Galileo+BDS+SBAS		16	
	GPS/QZSS		15	
Capture	GPS/QZSS+Galileo+GLONASS+SBAS		20	
	GPS/QZSS+GLONASS+SBAS		21	
	GPS/QZSS+Galileo+BDS+SBAS		17	

Parameter		Measured output	Nominal value parameter	Unit of measurement
	GPS/QZSS		15	
Standby mode		VBAT (VBAT = 3.3 V at room temperature. All conclusions disabled.)	15	μA

9 Hardware Description

9.1 Connectionnutrition

To ensure positioning efficiency, monitor the module's power supply ripple. It is recommended to use a low-dropout (LDO) linear DC voltage regulator with a maximum output current greater than 100 mA.

If power to the VCC pin is disconnected, the real-time clock (RTC) and battery-backed RAM (BBR) are powered via the VBAT pin. This allows orbital and time information to be retained, allowing for warm or warm starts.

If a backup power source is not available, connect the VBAT pin to VCC or leave it in a high-impedance state.

9.2 Antenna design

The module has a built-in LNA and SAW. It is recommended to use either a passive or active antenna with a gain of less than 30 dB.

The module has built-in short circuit protection and open circuit detection functions, which can detect the antenna status of normal connection, open circuit and short circuit, and send a status hint in NMEA data format.

Execution Module 1 features internal antenna short-circuit detection. If an overcurrent is detected on the ANT pin, the module will automatically disconnect this power source to prevent irreversible damage.

Execution Module 2 can detect an open circuit in the antenna. Users can determine this based on antenna status messages.

9.3 Resetting and managing modes

The reset (reboot) mode of the module is controlled by the RESET (nRESET) pin.

When the module powers on or the RESET state changes from low to high, the module performs an external reset. (If power to VBAT is always on, an external reset will not affect the ephemeris data in the backup domain.)

CAUTION! When connecting the RESET pin to any host I/O, do not use a pull-up or pull-down resistor.

10 Default messages

The default messages are shown in Table 10.

Table 10 - Default Messages

Interface	Settings
UART output	9600 baud, 8 data bits, no parity, 1 stop bit. Configured For transmissions protocol NMEA And binaryprotocol, But at launch were activated onlythe following NMEA messages: GGA, GSA, GSV, RMC, ZDA, TXT-ANT.
UART input	9600 baud, 8 data bits, no parity, 1 stop bit. Automatic baud rate detection disabled. Automatically accepts next protocols without configuration required: NMEA, binary protocol. The module supports interleaved NMEA messages and binary protocol
Temporal impulse (1 Hz)	1 pulse per second, synchronized to the front front, pulse duration 100 ms

Depending on the module's application, it is possible to disable the main power supply to further reduce power consumption. To prevent the serial interface's high logic level from interfering with normal operation, it is strongly recommended to disable the serial port when disconnecting the main power supply. Otherwise, set the serial port on the host to input mode or to a high-impedance state using a pull-up resistor.

11 Module dimensions

The dimensions of the module are shown in Figure 4.

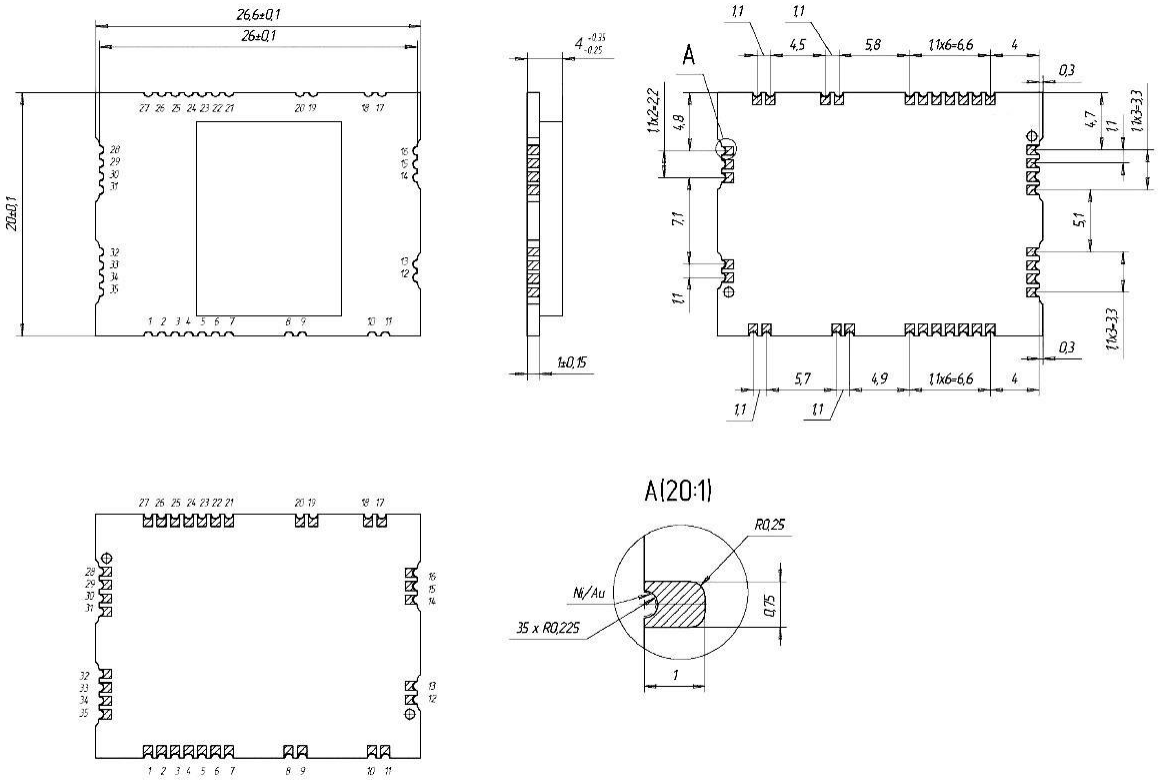

Figure 4 – Module dimensions.

12 Typical connection diagram

The typical connection diagram for modules of versions 1 and 2 is shown in Figures 5, 6 and 7. The wave impedance from the ANT pin to the antenna connector should be 50 Ohm.

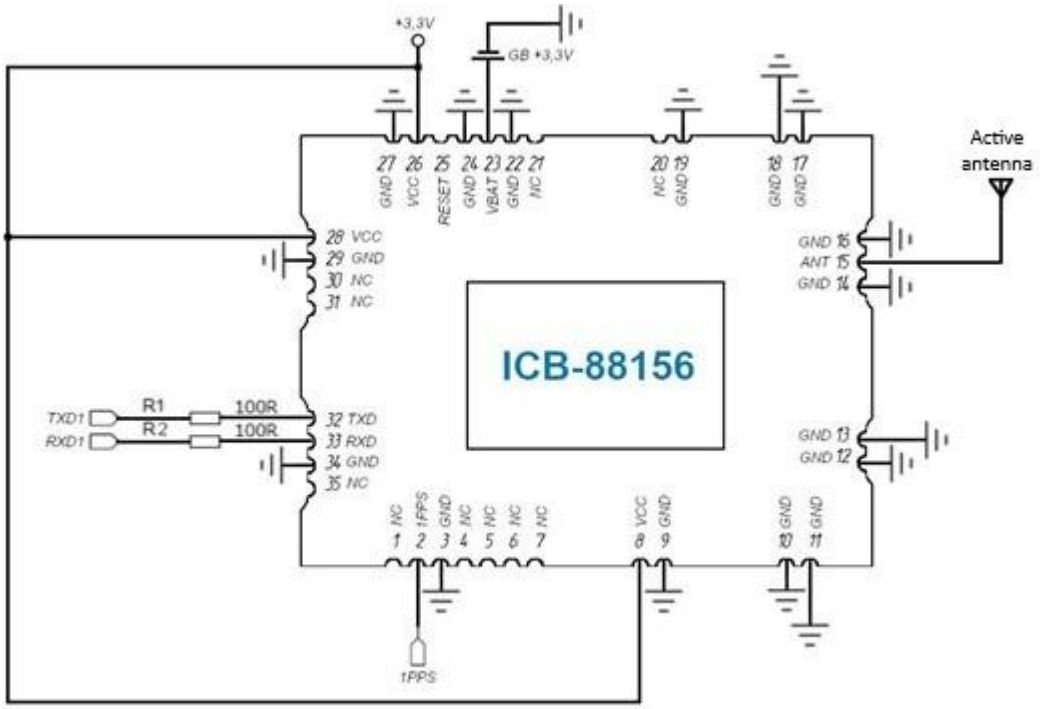

Figure 5 – Typical connection diagram of the version 1 module to the active antenna.

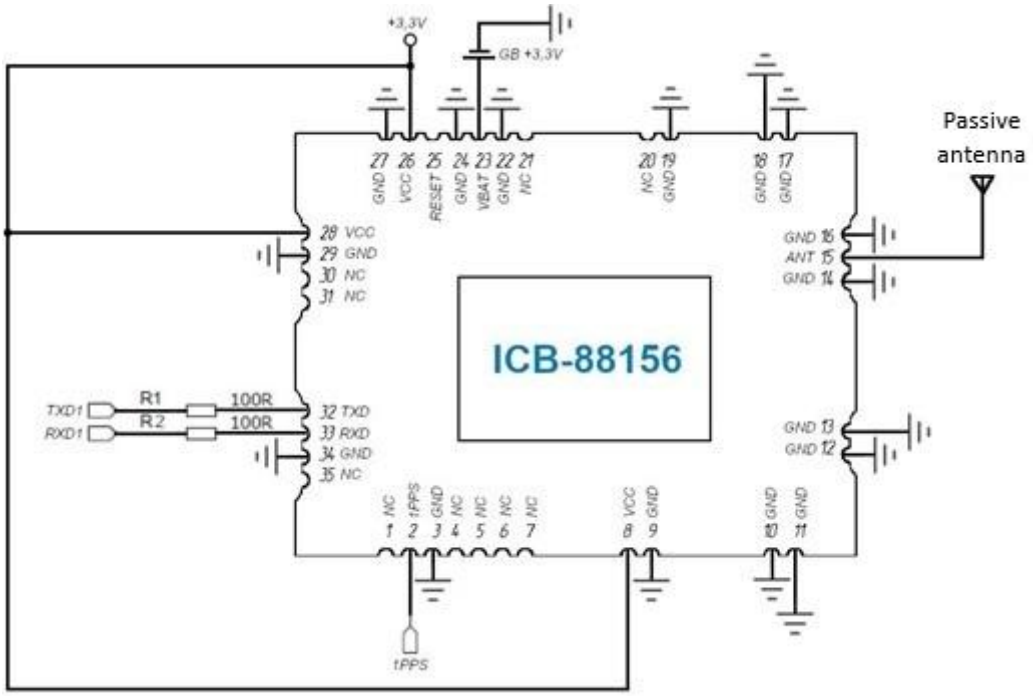

Figure 6 – Typical connection diagram of the execution module 2 to the passive antenna.

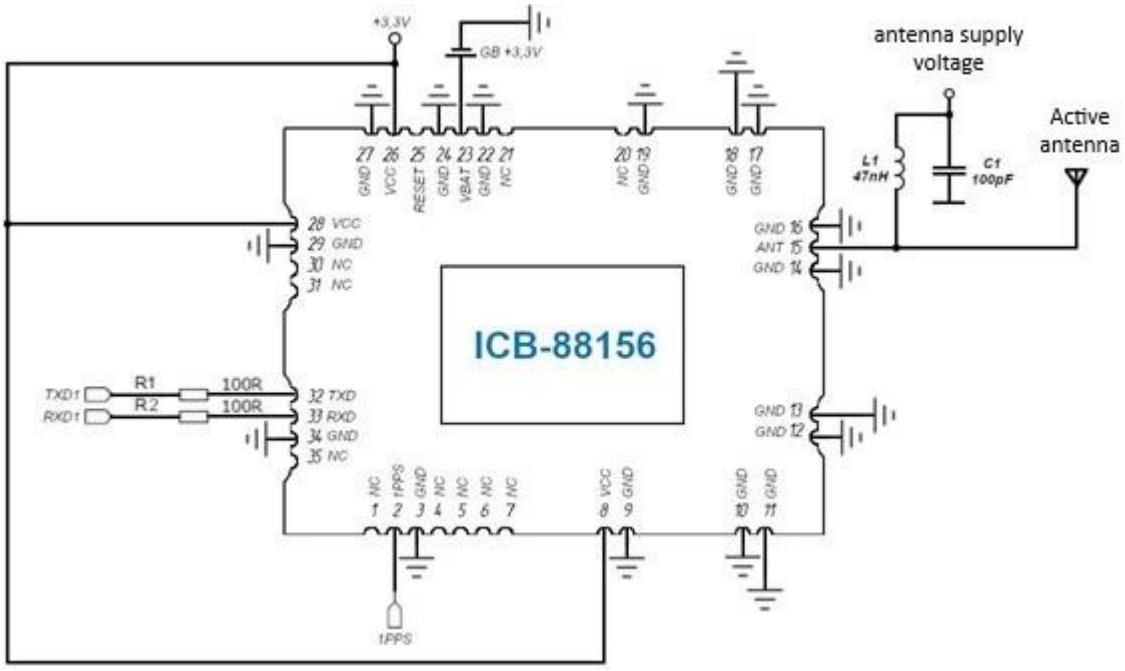

Figure 7 – Typical connection diagram of the version 2 module to the active antenna with external power supply.

13 Printed circuit board module footprint standard

The standard footprint of the printed circuit board module is shown in Figure 8.

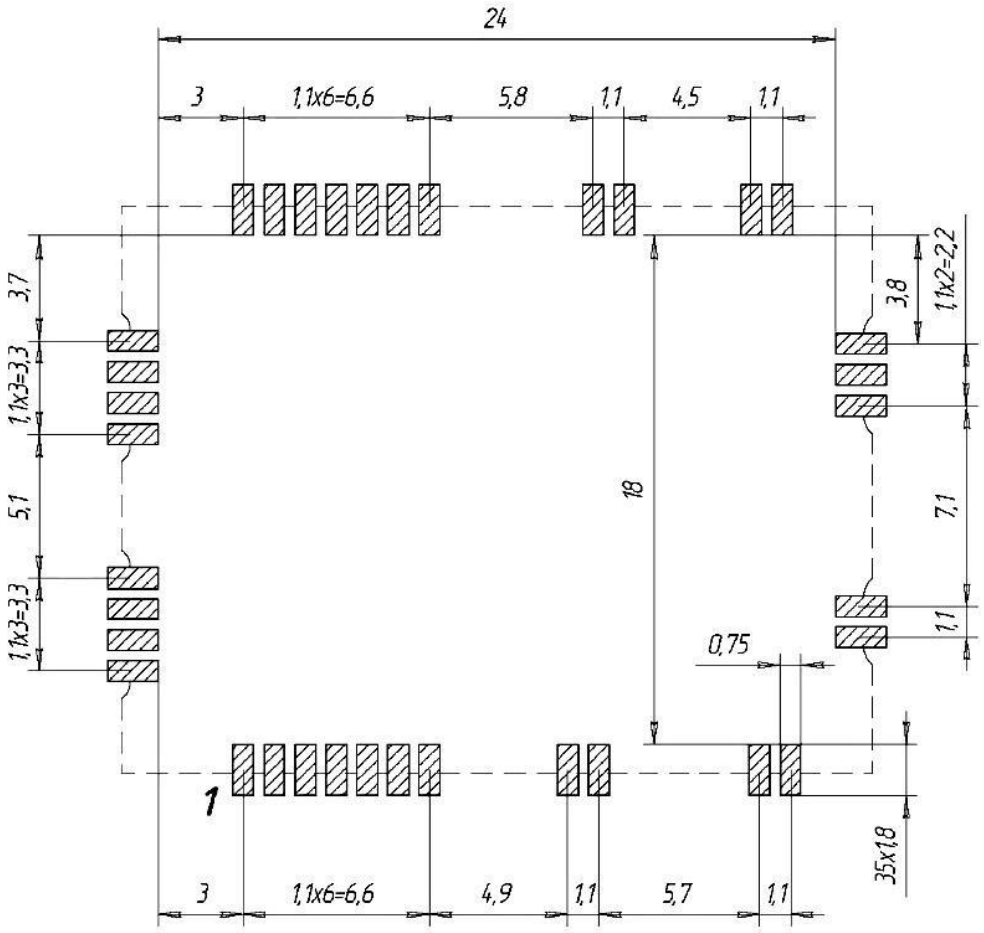

Figure 8 – Standard printed circuit board module footprints

It is necessary to ensure that there are no conductive surfaces beneath the module. The best option is to place a solder-mask-protected polygon beneath the module, connected via vias to the ground plane of the printed circuit board.

14 Recommendations for PCB layout and component layout her

The width of the radio frequency (RF) trace between the RF terminal and the antenna interface must be greater than 0.2 mm. The characteristic impedance of the RF jitter between the RF terminal and the antenna interface must be controlled and equal to 50 ohms.

Do not place the module near any sources of electromagnetic interference such as antenna, RF signals, DC/DC or power conductor, clock signal or other high-frequency switching signal, etc.

15 Maintenance

The module is a maintenance-free product and is designed to operate for an indefinite period of time, provided that the operating conditions are met: stable power supply within the specified voltage range, air humidity and temperature, and the absence of mechanical shock.

16 Instructionssecurity measures

16.1 Precautions for reflow mounting of the module in an oven

The module is a moisture-sensitive device. Avoid exposure to moisture and its accumulation on the module. Before surface mount reflow, ensure it is free of moisture or dry.

16.2 Precautions when handling the module to prevent damage from electrostatic discharge

The module is an electrostatic-sensitive device. Observe safety precautions when handling the module! Failure to observe safety precautions may result in serious damage to the module!

Particular care should be taken when handling patch antennas due to the risk of electrostatic discharge. In addition to standard ESD safety practices, the following precautions should be taken when handling the module:

1) If there is no galvanic connection between the local ground (i.e. workbench) and the PCB ground, then the first point of contact when handling the PCB should always be between the local ground and the PCB ground;

2) Before installing the patch antenna, connect the device to ground;

3) When handling the ANT contact, do not touch charged capacitors and be careful when in contact with materials that can accumulate charges (e.g. patch antenna ~10 pF, coaxial cable ~50-80 pF/m, soldering iron);

4) To avoid electrostatic discharge through the RF input, do not touch the installed patch antenna;

5) When soldering RF connectors and patch antennas to the RF terminal of the receiver, it is necessary to use a soldering iron with ESD protection (sting).

17 Storage and transportation rules

Climatic conditions for transportation must meet the following conditions:

- ambient air temperature from minus 40°C to plus 85°C;
- atmospheric pressure from 84.0 to 107.0 kPa (from 630 to 800 mmHg).

The module must be stored indoors at an air temperature of -40°C to +85°C. Storage areas must be free of aggressive impurities (acid and alkali vapors).

18 Guaranteesmanufacturer (supplier)

The warranty period for the module is set at 1 year, counting from the date of transfer of the module to the buyer.

Modules that fail during the warranty period are subject to replacement or repair by the manufacturer at the manufacturer’s expense.

The user loses the right to free repair or replacement during the warranty period in the event of mechanical damage to the module caused by the user's fault.