Features

- **Integrated GNSS-antenna** for a compact size;
- **Full set of navigation sensors**: 3-axis gyroscope, 3-axis accelerometer, 3-axis magnetometer, barometer (altimeter), GNSS receiver (concurrent Galileo, GLONASS, GPS / QZSS);
- Powerful MCU running **Kalman filter** for sensor fusion at high rates;
- **Thermal stabilization** to keep stability over a big range of environmental temperatures;
- **Full factory calibrations** made on special equipment;
- **Onboard SD card** for a high-rate data logging with a flexible set of data to be recorded;
- Backup battery for a **fast GNSS start** and real-time clock;
- Open Serial API protocol allows **seamless integration** with third-party applications
- **Optimized for gimbals** and compatible with all versions of the SimpleBGC32 controllers*
- Support of external **high-grade sensors** (fiber-optic gyroscopes)
- **Cost-effective solution** compared to other GNSS-enabled solutions on the market

Hardware versions

GPS IMU 1.2 – IMU / AHRS with integrated GNSS receiver as a single unit

GPS IMU Split 1.0 – IMU / AHRS as a separate module, connected to the GNSS receiver module using Basecam proprietary CAN protocol

** For a full support of all functions listed in this manual, it's required to update the main controller and GPS IMU firmwares to the most actual versions.*

Overview

The **Basecam GPS IMU** is an GNSS-aided compact AHRS/IMU module developed by Basecamelectronics company to work as a main or an external IMU sensor** with all versions of the SimpleBGC32 controllers*. It has much better precision compared to the internal IMU sensor, that allows improving precision of stabilization in demanding applications, where the regular IMU sensor does not work reliably.

GPS IMU connects to any free UART port of the main controller, or common CAN bus**, and provides precise attitude and heading information, that can be used as a reference to correct the internal IMU sensor, solving its common problems: gyroscope drift, an affection of linear accelerations, drift caused by the changes in environmental temperature.

*** In SBGC32 controllers the "main IMU sensor" is used in a stabilization loop, while the "external sensor" is used for corrections. Main role is available over CAN interface, external role over UART interface.*

Document revision: 1.1.139 (19. Aug. 2025)
Hardware version: GPS_IMU 1.2, GPS IMU Split 1.0
Firmware version: 2.32

Specifications

GPS IMU 1.2 mechanical data	
Max. dimensions	73×51×30 mm
Weight	47 g
Mounting holes	3 mm × 4
Split Sensor 1.0 mechanical data	
Max. dimensions	55×39×14.5 mm
Weight	?? g
Mounting holes	3 mm × 2
Split Receiver 1.0 mechanical data	
Max. dimensions	64×57.5×20 mm
Weight	?? g
Mounting holes	3 mm × 4

Communications	
GPS IMU 1.2 Interfaces	2× UART 1× micro USB 1× CAN 1× I2C for external sensors 1× microSD
Split Sensor 1.0 Interfaces	2× UART 1× USB Type C 2× CAN 1× I2C for external sensors 1× microSD
Split Receiver 1.0 Interfaces	3× UART (2 as connectors, 1 as pads) 1× CAN
Max. baud rates	UART: 2 MHz, I2C: 800 kHz, CAN: 2 MHz
Protocols	See "Basecam GPS_IMU Serial API" for a protocol specification
Data output	· Raw sensors data (accelerometer, magnetometer, barometer, gyroscope, GNSS) · Attitude (quaternion, DCM, Euler) · Angular rate · Navigation position and velocity · Date and time · Status information
Max. data output rate	200 Hz by UART 1250 Hz by CAN (faster rates available by request)

Absolute maximum ratings	
Working temperature	-40..+85 °C
Acceleration	1000G for 1 ms
ESD rating	HBM: Class 2, 2000 V CDM: Class 3, 250 V

Electrical	Min	Typ	Max
Power supply	4.5 V	5 V	5.5 V
Drawn current (at 5V)		150 mA	400 mA (warming up)
Thermal stabilization		250 mWt	1500 mWt
Backup rechargeable battery (ML1220)		3V	
- current drawn in backup mode		16 µA	
- lifetime (estimated)		41 days	
- full charge (estimated)		34 hours	

Performance		
Startup time	1 seconds (communication ready) 3 seconds (first valid data ready)	
GNSS best lock time**	Cold Hot	26 s 1 s
GNSS receiver sensitivity	Tracking & Navigation Reacquisition Cold start Hot start	−165 dBm −158 dBm −146 dBm −155 dBm
GNSS systems	Galileo, GLONASS, GPS, QZSS concurrently	
GNSS receiver update rate	10 Hz	
Internal update rates	Gyroscope, accelerometer Magnetometer Attitude and heading Position & velocity	2000 Hz 100 Hz 250 Hz 250 Hz
Angular velocity limits	±2000 deg./sec.	
Acceleration limits	16G	
Magnetic field strength limits	16 Gauss	
Factory calibrations	Gyroscope and accelerometer full parameters: bias, scale and cross-axis (at the single working temperature point) Magnetometer bias and scale (at the single working temperature point)	
Thermal stabilization	Setpoint (adjustable): Time to warm up (typ.): - from 0°C to 50°C - from 20°C to 50°C	50 °C 40 sec. 25 sec.

Installation

When choosing a position for the GPS IMU module, take into account the following conditions that are mandatory for a normal work of all sensors:

Magnetometer: as a magnetic field of the earth is very weak, even relatively small external magnetic fields can distort the measurements. Try to keep magnetometer as far as possible from a soft iron (ferromagnetic metal parts, screws) and a hard iron (permanent magnets). If it's hard to avoid those factors, it's recommended to calibrate magnetometer after installing in a new position. Such calibration is able to compensate affection of the hard iron and soft iron. It's extremely important to keep a magnetometer far away from variable magnetic fields that can't be calibrated: electric motors, power supply cables, ferromagnetic parts that can change their position.

GNSS receiver: keep a clear view of the sky from the top surface of the enclosure for the best GNSS-signal reception; do not place metallic material that can obscure signal, too close to it; keep electronics that emits EMI noise or strong signals that can interfere GPS signal, as far as possible.

Gyroscope and accelerometer: try to minimize the level of vibrations, as they seriously impact these sensors.

Barometer: keep free access of outside air but prevent strong airflows that may create variations of pressure inside the box where sensor is located.

Choosing a location on a gimbal

SimpleBGC32 system supports several mounting positions for the GPS IMU: on the stabilized platform, on the gimbal's arms, or on the outer frame. All possible orientations are supported if preserving the X,Y,Z axes alignment (i,e, rotated by 90-degree steps from the normal position).

Choose a position considering requirements for a normal work of all sensors. Take into account that the rotating joints between the external IMU and the stabilized platform may add additional errors caused by the sum of errors in angles measured by the encoders, flexibility of joints, arms or a suspension of a gimbal (like vibration dampeners).

GPS IMU Split version has an advantage compared to the regular version: it allows to place the “Sensor” module on the stabilized platform and choose the most optimal place for the “Receiver” module (which encapsulates a GNSS receiver and a magnetometer), considering the above-mentioned requirements. All modules are connected using the common CAN bus routing through the whole gimbal.

Electrical connection

If GPS_IMU is connected by UART interface, it can be used only as an *External IMU*, providing attitude/heading corrections for the *Main IMU*. If connected by CAN interface, it can be either used as a Main IMU (installed on the camera platform and used for a stabilization), or as an External IMU *(frw. ver. 2.72.x or later)*.

For **GPS IMU Split** version, both modules are connected to the common CAN bus of the SBGC32 gimbal controller*. The “Sensor” module is used in a main IMU role and has to be mounted on the stabilized platform. The “Receiver” module can be installed at any place of a gimbal – the software will estimate its relative position using a configured gimbal geometry and angles of motors located between the modules.

* *The configuration using CAN connection can't works standalone, SBGC32 controller is needed.*

WARNING: A special attention should be paid to the power supply voltage and current capability! GPS IMU consumes significant current at startup to warm up its internal heater, and **voltage should not drop below ~4.1 V** as absolute minimum working value! Ensure that electrical cable and connectors have low resistance, especially when using a long cable, to prevent voltage drop in it. In case of troubles with too low voltage at startup, it may help to reduce the value of parameter "IMU_HEAT_PWR."

Setting up a gimbal controller

Please refer to "SimpleBGC32 User Manual 2.6x", section 18 "Using an external IMU sensor to improve the precision of stabilization".

SimpleBGC32 GUI version 2.68b7+ provides a dedicated tool to show diagnostics information for the connected GPS IMU module. Also, from this tool it's possible to make sensor's calibrations, change some parameters (*in frw. ver. 2.32+, GUI ver. 2.73+*) and to upgrade the firmware.

Backup battery

Rechargeable battery provides a backup for the real-time clock and data for a "warm start" of GNSS receiver. It's required to charge it first time or after a long delay in use, by connecting +5V power supply (~30 hours for a full charge). Device is operational even if battery is not charged. The status of the battery may be checked among other diagnostic information in the SimpleBGC32 GUI version 2.68b7+.

There is an option to replace rechargeable battery to a regular lithium battery of 1216-1225 size. You have to cut the jumper "BACKUP_SOURCE" on the PCB to disconnect charging circuit.

Sensor calibrations

This module has a full set of factory calibrations for accelerometer and gyroscope made on a special equipment. The magnetometer sensor has no factory calibrations, because it need to be calibrated only after installation of the module into environment where it will be used. Factory calibrations are stored in the EEPROM and SD card.

You can re-calibrate selected sensors at any time if for some reasons factory calibration becomes obsolete. To do that, check that parameters ACC_PRIORITY и GYR_PRIORITY in the file SD > CALIB > IMU.INI are set to 2:

1 – use calibration data from EEPROM
2 – use calibration data from SD card
0 – restore factory data from EEPROM to SD card (then this option is changed to 2)

IMPORTANT: before starting sensor calibration, wait at least 1 minute after powering ON the device, to let it warm up to working temperature! Otherwise, calibrations will be not precise.

Calibrating magnetometer (biases and scales)

It is advised to re-calibrate magnetometer after the installation in a new mounting position or after serious changes in the magnetic environment. Calibration removes the interference of the hard and soft iron located near the device.

1. Press the service button 3 times quickly to start calibration.
2. Rotate device by all directions to collect data in multiple different orientations. This step is divided into 2 phases:
   a) At the first 7-8 seconds system collects a time-separated data points. During this time, it's important to make several long rotations by at least two axes. Green LED flashes with a constant rate.
   b) Then the system collects the remaining number of data points separated by the angle from each other. The short pulse of green LED signals an acceptance of each new point. Rotate device to different angles until the required number of points are collected.
3. When enough points are collected, the system computes calibrations values and emits a series of short pulses by the green LED, which means that the calibration was finished successfully.

There are several runtime auto-calibration options available for the magnetometer sensor, improving its performance in a harsh magnetic environment. Check the parameter MAG_AUTO_CALIB in CONFIG.INI

Calibrating gyroscope (biases only)

1. Make a single short press on the service button
2. Fix the device firmly, preventing any motion, rotation or vibration until calibration will be finished.
3. Green LED flashes 2 times per second while the device collects data. It takes several seconds.
4. When finished, system emits a series of short pulses by the green LED.

Calibrating accelerometer (biases and scales)

This procedure needs to place the device in 6 positions in a sequence, making each axis to point exactly up and exactly down. The order of the sequence of positions does not matter.

1. Place the device in the first position in order (for example, Z-axis pointing down) and fix it. A tolerance of 2-3 degrees is allowed.
2. Press the service button 2 times quickly to start calibration in this position.
3. Fix the device firmly, preventing any motion, rotation or vibration until calibration will be finished.
4. During the calibration, the green LED flashes 2 times per second. When finished, it makes 2 short flashes and device returns to normal operation.
5. Move the device to the next position in order and repeat steps 1-3.

When all 6 positions are passed, system computes calibration values and emits a series of short pulses by the green LED.

LED status indication

The multicolor LED signals the basic modes of operation by color:

— Green — GNSS receiver is used in a solution. This is the main working mode when there is a good reception of the GNSS signal.

— Yellow — GNSS receiver is not used; device provides attitude and heading information without the compensation of accelerations; position and velocity information is undefined.

— Red — hardware fault, device is not operational. Error is encoded by a flashing sequence followed by short pause. Denoting"•" for a short blink, "–" for a long blink:

SD card error: • –

IMU error: – • • •

MAG error: – • – •

Protection error: – • •

CAN BUS error / off state: • • • •

External sensor error: • •

Several errors occurred: •••••• (fast blinking with no pause)

- When a connection to the external host is established and device sends data, LED flashes 2 times per second: — — — — — or — — — — —

Service button

- **1 click** – calibrate gyroscope
- **2 clicks** – calibrate accelerometer (single position)
- **3 clicks** – calibrate magnetometer
- **long press** – in calibration mode, stops current calibration and cancels the result. In normal mode, if connected by USB, enters mass-storage device mode. Device appears as a USB disc allowing to work with the content of the installed SD card. Functions that require access to the SD card (like calibrations, data logging) will be unavailable in this mode.

General configuration parameters

General configuration parameters are located in the "CONFIG.INI" which you can find in the root directory of the SD card. Selected parameters can be modified from SimpleBGC GUI (ver. 2.73 and above) when GPS_IMU is connected to the gimbal controller, using “Show status..” dialog.

Name	Default value	Range	Units	Description

IMU_HEAT_TEMP	50	-40 – +80	°C	Thermostat temperature for IMU
IMU_HEAT_PWR	500	0 – 1500	mW	Maximum heater power for thermostat that will be consumed from power supply
UART0_BR	115200	9600 – 921600	Bd	Baud rate for UART0 (internal)
UART0_CFG_BR	115200	9600 – 921600	Bd	Baud rate at initial configuration. If 0, then function is disabled.
UART0_FUNCTION	2			Internal UART function: 0 - disable, 1 — proxy connection to the primary GNSS for monitoring, 2 — internal GNSS, 3 — secondary backup GNSS, 4 - RTK rover, 5 - RTK move base, 6 - Serial API
UART1_BR	115200	9600 – 921600	Bd	Baud rate for UART1
UART1_CFG_BR	115200	9600 – 921600	Bd	Baud rate at initial configuration. If 0, then function is disabled.
UART1_FUNCTION	6			0 - disable, 1 — proxy connection to the internal GNSS for monitoring, 2 — external GNSS as replacement for the internal GNSS, 3 — secondary backup GNSS, 4 - RTK rover, 5 - RTK move base, 6 - Serial API
UART1_AHRS_RATE*	0	0 – 200	Hz	Frequency of sending data for AHRS_RATE. Disabled when set to 0.
UART1_HELPER_RATE*	0	0 – 200	Hz	Frequency of sending data for HELPER_RATE. Disabled when set to 0.
UART2_BR	115200	9600 – 921600	Bd	Baud rate for UART2
UART2_FUNCTION	0			0 - disable, 1 — transparent connection to the internal GNSS, 2 — external GNSS as replacement for the primary GNSS, 3 — secondary backup GNSS, 4 - RTK rover, 5 - RTK move base, 6 - Serial API
MAG_AUTO_CALIB2	0	0 – 2		Conditions for the automatic in-run calibration of the magnetometer sensor: 0: disabled 1: when a high-enough rate of rotation is detected 2: when a rotation or cross-sensor misalignment error are detected
UTC_TIME_ZONE	0	0 – 24	Hour	UTC time zone
DYNAMIC_MODEL	4	0 – 8		Dynamic platform model: 0: portable 2: stationary 3: pedestrian 4: automotive 5: sea 6: airborne with <1g acceleration 7: airborne with <2g acceleration 8: airborne with <4g acceleration
GNSS_ASSIST**	0	0 – 8		GNSS quick start assist method: 0: disabled 1: use last obtained navigation data
HEADING_SOURCE**	0	0 – 1		Heading estimation method:

				0: magnetometer (compass) 1: direction of motion, for the applications where IMU is mounted on the vehicle moving only in one direction with the steering (cars, bikes, trains, etc.) 2: RTK baseline
COURSE**	0	-180 – 180	deg	For the HEADING_SOURCE=1 defines the angle between the IMU installation and the “forward” direction of motion
RTK_BASELINE_LENGTH	0		m	RTK baseline length
RTK_BASELINE_DEV	0.05		m	RTK baseline max deviation
RTK_BASELINE_COURSE	0		deg	RTK baseline angle
EXT_SENS_MODEL	NONE			External sensor type name. • FG50 - 1-axis gyroscope connected to UART2. In CALIB/EXT_IMU.INI set GYRO_SCALE > 1000 for the working axis. The actual value for scale factor is provided by the manufacturer.
FILTER_MODE_FLAGS				Sensor fusion modifier flags. See Serial API specification for definition or edit it using GUI → “Show status” tool
ACC_WEIGHT	1			Relative weight of accelerometer in sensor fusion (GNSS is disabled)
GNSS_WEIGHT	1			Relative weight of GNSS in sensor fusion
MAG_WEIGHT	1			Relative weight of magnetometer in sensor fusion

Remarks:

* If parameter is enabled, module sends CMD_AHRS_HELPER or CMD_HELPER_DATA messages to the SimpleBGC32 gimbal controller. Use it for compatibility with the old versions of firmware prior to 2.68x that does not support GPS_IMU module natively: GPS_IMU should be mounted on the gimbal's frame and initiate sending data for correction of the gimbal's internal IMU sensor.

** Development is in progress

Data logging

GPS IMU is able to save realtime data to log files in the on-board SD card in a format SCSV (semicolon-separated values). Up to 2 independent channels can be configured (for example, to log some data at high rates, other data at low rates).

Log configuration parameters are located in the "CONF_LOG.INI" which you can find in the root directory of the SD card, and have the following format:

```
LOG<ch>_<name>=<value>,
```

where

<ch> – channel (1 or 2)
<name> – name of the parameter or name of the data set
<value>– value of the parameter

To select which data to log, set "1" or "2" to the corresponding data sets, for example:

LOG1_GYR_XYZ=0 - disabled

LOG1_GNSS_POS_LLA=1 - enabled, log instant values
LOG1_ACCEL_XYZ=2 - enabled, average values of the variable between log events

The full list of available datasets can be found in the document "Basecam GPS IMU Serial API" .

Additional parameters:

- LOG<ch>_INTERVAL_MS – interval between the data samples, from 5 to 60000 ms.
- LOG<ch>_SYNC_PERIOD_MS – how often new portions of data will be synchronized with the file allocation table (FAT)
  NOTE: do not set SYNC_PERIOD_MS too low, because SD card has a limited lifetime resource for the "write" cycles.
- LOG<ch>_FILES_TO_ROTATE - number of files to keep in rotation scheme, 1..98. When the new log file is created, the oldest file is deleted.

User-defined data logging

Host controller being connected via Serial API, can send a user-defined external data that will be logged together with the internal IMU data. To send this data, use CMD_USER_DATA_LOG message. To define which data is enabled for logging in the configuration, use CMD_GET_USER_CONF_LOG message. The following parameters defines how to log external data:

- LOG_USER_CH<pipe_idx>_NAME=<name_of_pipe>
  - <pipe_idx> - bit position in the "ACTIVE_PIPE_MASK" parameter, starting from 0
  - <name_of_pipe> - name to be logged in the header of log file. If pipe contains more than one value, index will be appended
- LOG<ch>_USER_CH<pipe_idx>_CONF=<data_type>;<data_size>;<is_enabled> - data format for each pipe
  - <ch> - main loggin channel, 1 or 2
  - <data_type>: 1 - float, 2 - int32, 3 - int16
  - <data_size>: number of values in a pipe, 1..15
  - <is_enabled>: 1 if pipe should be logged, 0 to skip it

Example:

```
LOG_USER_CH0_NAME=USER_TIMESTAMP
LOG1_USER_CH0_CONF=3;1;1
LOG_USER_CH1_NAME=IMU_ANGLE
LOG1_USER_CH1_CONF=1;3;1
LOG_USER_CH2_NAME=BATTERY_VOLTAGE
LOG_USER1_CH2_CONF=3;1;1
```

NOTE: when implementing user data logging on a host side, remember that the payload size in the CMD_USER_DATA_LOG message it limited by 255 bytes according to Serial API's specification. You can send exceeding data in a separate message, properly specifying which pipes are included by the ACTIVE_PIPE_MASK parameter.

SBGC32 gimbal controller, used as a host controller with the GPS_IMU used as an "External IMU", allows logging of its realtime data. More information is provided in Appendix A: Logging data from SBGC32 gimbal controller.

Log file rotation

Log file has format LOG<ch>_<NN>.CSV, where

<ch> - channel
<NN> - sequence number in a rotation queue

Each time device is restarted, NN is selected from the unused numbers (01..99). If the number of files exceeds the maximum allowed (10 by default), file that goes next to the selected NN, is deleted.

Firmware update instructions

WARNING: always load a proper firmware that matches the hardware version of the device! The latest firmware can be downloaded from the www.basecamelectronics.com/Basecam_GPS_IMU/

Updating firmware from SD card

This option works even if the device is unresponsive (i,e, previous attempt of updating firmware was failed and device is not accessible by any interface).

The sequence of actions to update the firmware from SD card:

1. Power off the device.
2. Copy the firmware file named "FWUPDATE.BIN" to the root directory of the SD card and install card into the device.
3. Turn on the device power or connect by USB cable to PC
4. Wait for the firmware update process to finish.

LED indication during the firmware update:

- ⊙ Flashing green: firmware updated is in progress
- ● Solid green: firmware is successfully updated
- ● Solid red: critical error, firmware can not be updated

Updating firmware from the SimpleBGC32 GUI

This option works if the GPS IMU module is connected to the main gimbal controller by the UART interface and is fully functional.

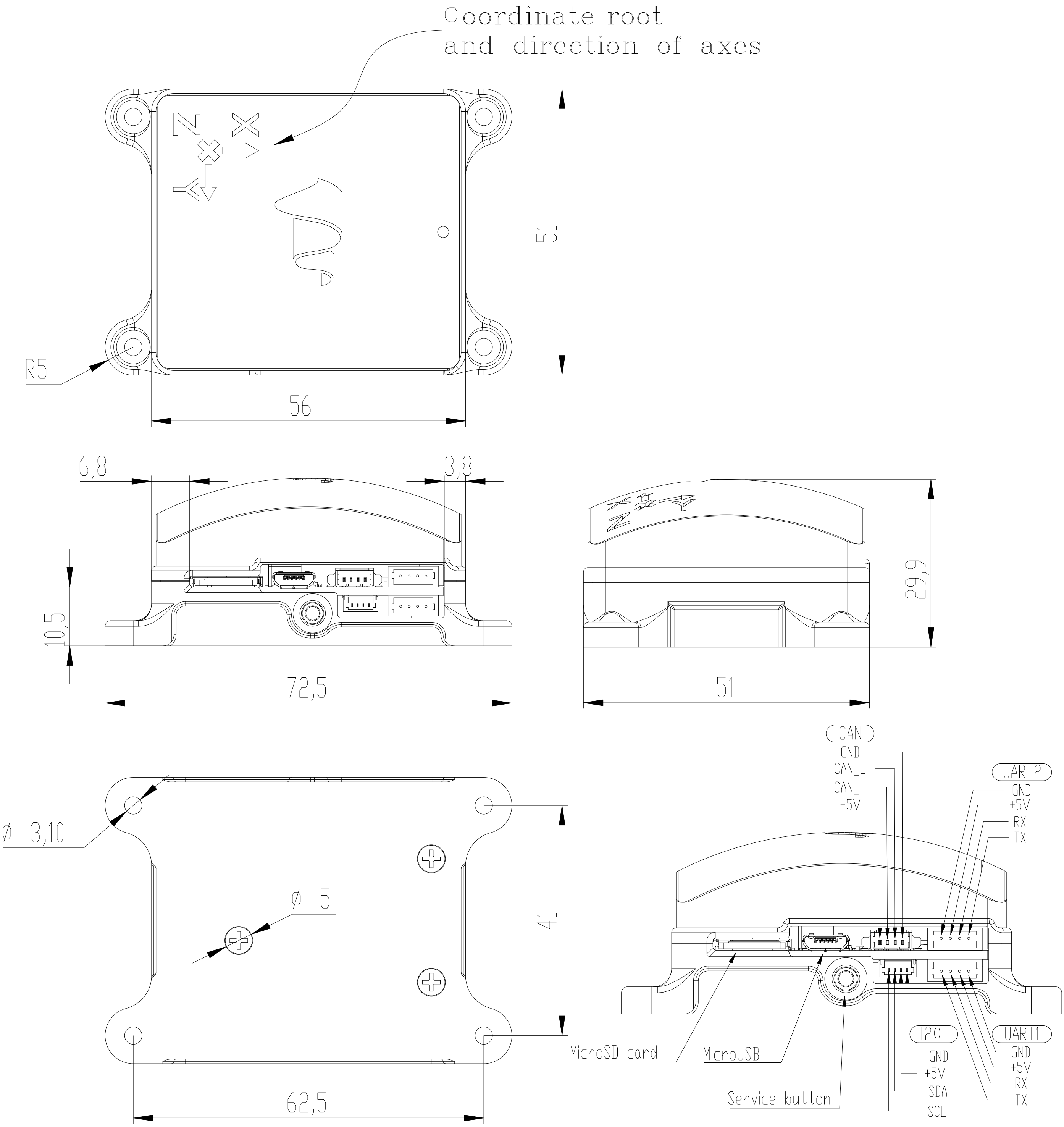
1. Connect the main SimpleBGC32 controller to PC (over USB, bluetooth or any other ways).
2. Run SimpleBGC32 GUI and connect it to the main controller.
3. Open "External IMU" tab and configure Basecam GPS IMU as described in the SimpleBGC32 User Manual (skip this step if it is already configured and works properly)
4. Press the "Show status" button to display information from the device in a new window
5. Press "Firmware update.." button, select *.hex file and press "Open". Firmware update process starts.

Important note: do not interrupt the updating process - it will make device inaccessible by the UART anymore! You still can use other methods to update the firmware.

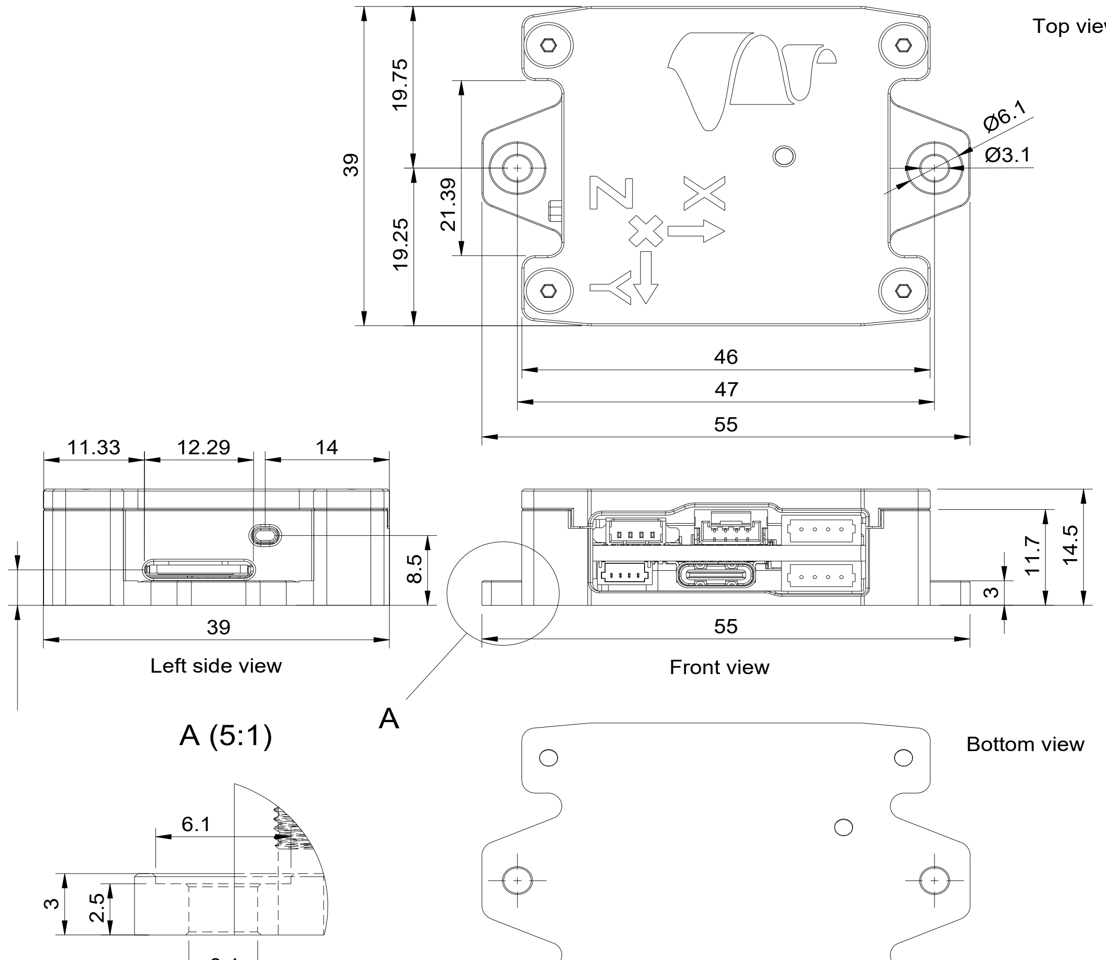
Updating firmware in USB DFU mode

This method works for experienced users only and requires additional steps to enter device into a bootloader mode. Please contact our support for more information.

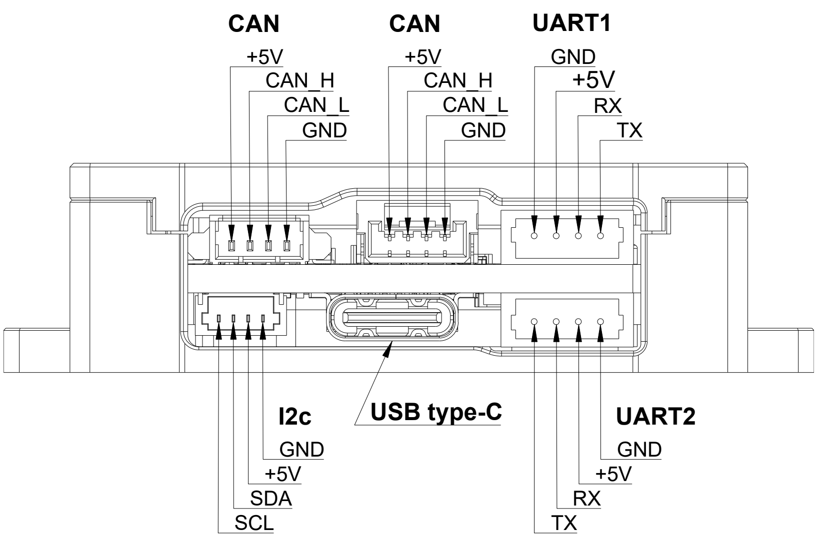
GPS IMU dimensions and pinout



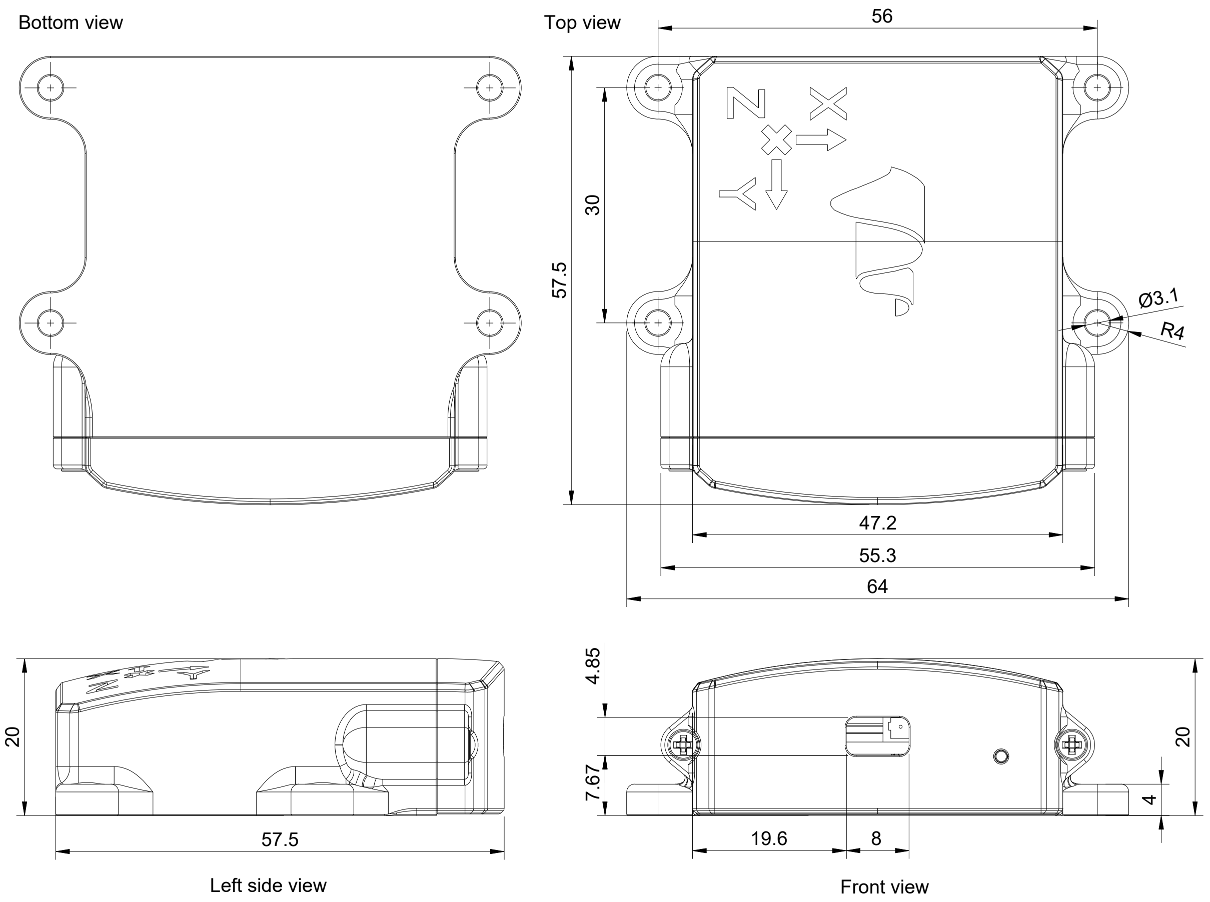
GPS IMU Split Sensor dimensions and pinout

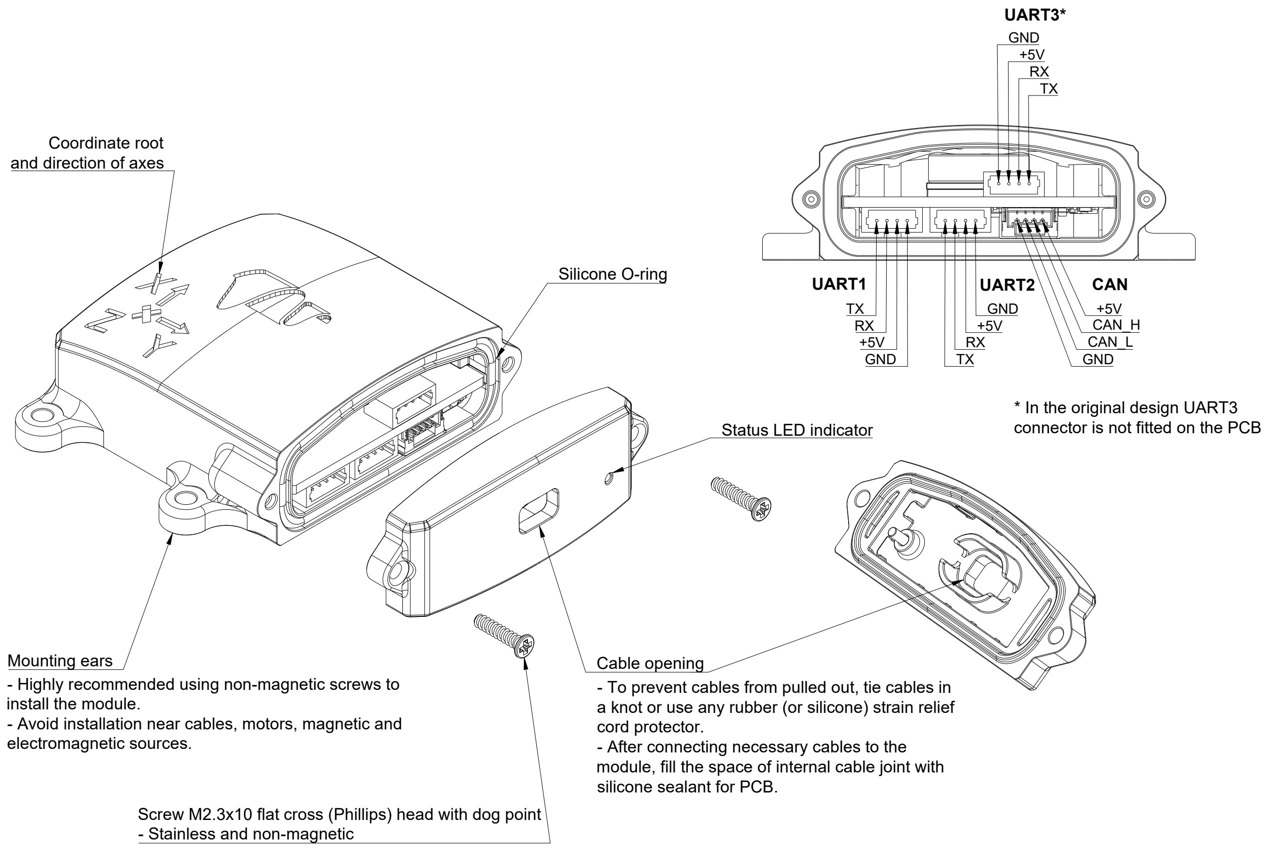


Mounting ears:
- Thickness for mounting bolt - 2.5 mm
- Main thickness - 3mm
- Use button or flat head non-magnetic M3 screws



GPS IMU Split Receiver dimensions and pinout





Connectors

CAN port

Socket
Board: Molex 0532610471 https://www.digikey.com/en/products/detail/molex/0532610471/699096
Cable: Molex 0510210400 https://www.digikey.com/en/products/detail/molex/0510210400/242844

Pins
Molex 0500588000 https://www.digikey.com/en/products/detail/molex/0500588000/634442
Molex 0500798000 https://www.digikey.com/en/products/detail/molex/0500798000/467835

Pigtails
Molex 0151340400 https://www.digikey.com/en/products/detail/molex/0151340400/6198146
Molex 0151340402 https://www.digikey.com/en/products/detail/molex/0151340402/6198148

UART port

Socket
Board: S4B-ZR-SM4A-TF(LF)(SN) https://www.digikey.com/en/products/detail/S4B-ZR-SM4A-TF-LF-SN/926602
Cable: ZHR-4 https://www.digikey.com/en/products/detail/jst-sales-america-inc/ZHR-4/608643

Pins
MINI-SZH-003T-P0.5 https://www.digikey.com/en/products/detail/jst-sales-america-inc/MINI-SZH-003T-P0-5/1651528
MINI-SZH-002T-P0.5 https://www.digikey.com/en/products/detail/jst-sales-america-inc/MINI-SZH-002T-P0-5/1651526
SZH-002T-P0.5 https://www.digikey.com/en/products/detail/jst-sales-america-inc/SZH-002T-P0-5/527363

Insulation displacement (IDC) style connector
04ZR-3H-P https://www.digikey.com/en/products/detail/jst-sales-america-inc/04ZR-3H-P/1678824
04ZR-8M-P https://www.digikey.com/en/products/detail/jst-sales-america-inc/04ZR-8M-P/1678835

Pigtails
A04ZR04ZR28H152A https://www.digikey.com/en/products/detail/jst-sales-america-inc/A04ZR04ZR28H152A/6009402
A04ZRE04ZRE26W305B https://www.digikey.com/en/products/detail/jst-sales-america-inc/A04ZRE04ZRE26W305B/9636220

I2C

Board: TE 1734709-4 https://www.digikey.com/en/products/detail/1734709-4/2077864
Cable: TE 1470364-4 https://www.digikey.com/en/products/detail/t1470364-4/2077840
Pins: TE 1734597-1 https://www.digikey.com/en/products/detail/1734597-1/2078044

Appendix A: Logging data from SBGC32 gimbal controller

When using together with the SBGC32 gimbal controllers, it is possible to log realtime data received from it. To enable logging, configure which data to request as described in the section “User-defined data logging”. The following table specifies all data available for logging:

data_name	Type	pipe_idx	data_type	data_size	Description
IMU_ANGLE_RAD[3]	float	0	1	3	IMU Euler angles, ROLL-PITCH-YAW *Units: radians*
GYRO_DATA[3]	int16	1	3	3	Data from gyroscope sensor with the calibrations applied, X-Y-Z *Units: 0,06103701895 degree/sec.*
IMU_REF_ERROR[2]	float	2	1	2	Module of error vector between the actual unit vector and the reference unit vector, for attitude and heading corrections in sensor fusion algorithm.
JOINT_ANGLE[3]	int16	3	3	3	Relative angle of joints between two arms of gimbal structure, in order ROLL-PITCH-YAW. Value 0 corresponds to “home” position. *Units: 0,02197265625 degree*
Z_VECTOR[3] H_VECTOR[3]	float	4	1	6	IMU attitude/heading in a form of gravity and heading vectors (allows to reconstruct a rotation matrix, DCM).
IMU_ANGLE[3]	int16	5	3	3	IMU Euler angles, ROLL-PITCH-YAW *Units: 0,02197265625 degree.*
TARGET_ANGLE[3]	int16	6	3	3	Setpoint angles (Euler ROLL-PITCH-YAW) *Units: 0,02197265625 degree.*
TARGET_RATE[3]	int16	7	3	3	Commanded rate (over Euler axes ROLL-PITCH-YAW) *Units: 0,06103701895 degree/sec*
ACC_DATA[3]	int16	8	3	3	Data from the accelerometer sensor with the calibrations applied. *Units: 1/512 G*
RC_DATA[6]	int16	9	3	6	RC signal value assigned to the ROLL, PITCH, YAW, CMD, FC_ROLL, FC_PITCH channels *Units: normal range is -16384..16384, -32768 is for 'undefined' signal*
RC_CHANNELS[15]	int16	10	3	15	Raw RC signal value from multi-channel RC input (sum-ppm, s-bus, spektrum, serial api). *Units: normal range is -16384..16384, -32768 is for 'undefined' signal*
MOTOR_OUTPUT	int16	11	3	3	Instant motor output, proportional to torque, where ±32767 corresponds to 100% (ROLL-PITCH-YAW order)
TEMP_SENS	int16	12	3	7	Temperature of IMU, Frame IMU, main MCU, on-board temp. sensor, ext. motor temp sensors (ROLL, PITCH, YAW). *Units: °C*
SYSTEM_ERRORS	int16	13	3	6	Array of system errors: 1: Error flags 2: Emergency stop error sub-code 3: I2C errors counter 4: CAN bus errors counter 5: CAN bus error flags: (bit0: warn irq, bit1: passive irq, bit2: off irq) 6: COM port errors counter

TMP_VARS_F	float	14	1	10	Temporarily variables used in scripts
TMP_VARS_16	int16	15	3	10	Temporarily variables used in scripts, rounded to 16bit integer

** This function is supported by the "Extended" family of controllers loaded with frw. ver. 2.69b7 and later and GPS_IMU being configured as an "External IMU". A support of logging in the "Main IMU" role to be added later.*

Configuration of SBGC32 data in CONF_LOG.INI:

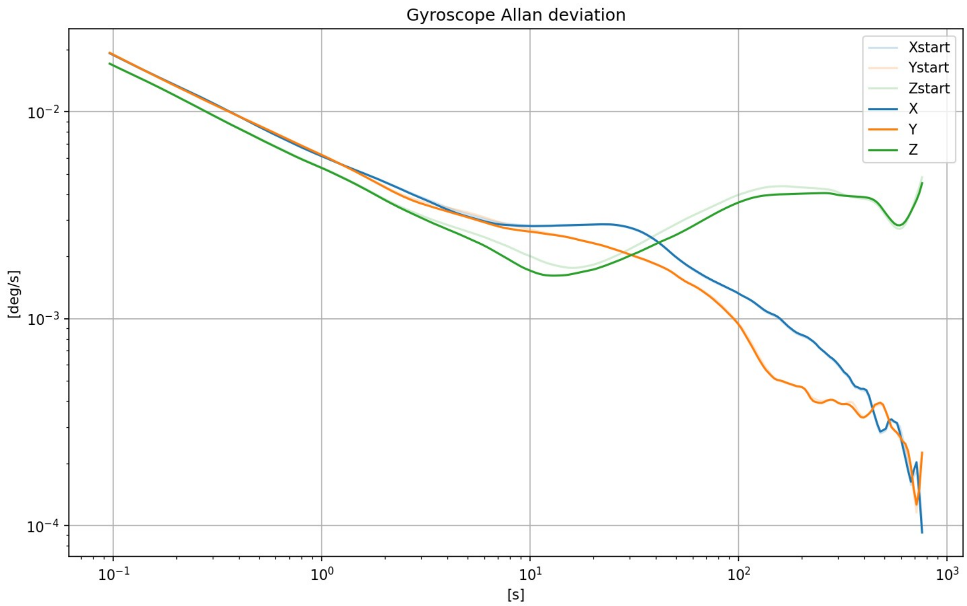
```
LOG_USER_CH0_NAME=IMU_ANGLE_RAD
LOG_USER_CH1_NAME=GYRO_DATA
LOG_USER_CH2_NAME=IMU_REF_ERROR
LOG_USER_CH3_NAME=JOINT_ANGLE
LOG_USER_CH4_NAME=Z_H_VECT
LOG_USER_CH5_NAME=IMU_ANGLE
LOG_USER_CH6_NAME=TARGET_ANGLE
LOG_USER_CH7_NAME=TARGET_RATE
LOG_USER_CH8_NAME=ACC_DATA
LOG_USER_CH9_NAME=RC_DATA
LOG_USER_CH10_NAME=RC_CHANNELS
LOG_USER_CH11_NAME=MOTOR_OUTPUT
LOG_USER_CH12_NAME=TEMP_SENS
LOG_USER_CH13_NAME=SYSTEM_ERRORS
LOG_USER_CH14_NAME=TMP_VAR_F
LOG_USER_CH15_NAME=TMP_VAR
...
# All pipes are disabled, change trailing 0 to 1 to enable only required pipes
LOG1_USER_CH0_CONF=1;3;0
LOG1_USER_CH1_CONF=3;3;0
LOG1_USER_CH2_CONF=1;2;0
LOG1_USER_CH3_CONF=3;3;0
LOG1_USER_CH4_CONF=1;6;0
LOG1_USER_CH5_CONF=3;3;0
LOG1_USER_CH6_CONF=3;3;0
LOG1_USER_CH7_CONF=3;3;0
LOG1_USER_CH8_CONF=3;3;0
LOG1_USER_CH9_CONF=3;6;0
LOG1_USER_CH10_CONF=3;15;0
LOG1_USER_CH11_CONF=3;3;0
LOG1_USER_CH12_CONF=3;7;0
LOG1_USER_CH13_CONF=3;6;0
LOG1_USER_CH14_CONF=1;10;0
LOG1_USER_CH15_CONF=3;10;0
```

Appendix B: Allan deviation

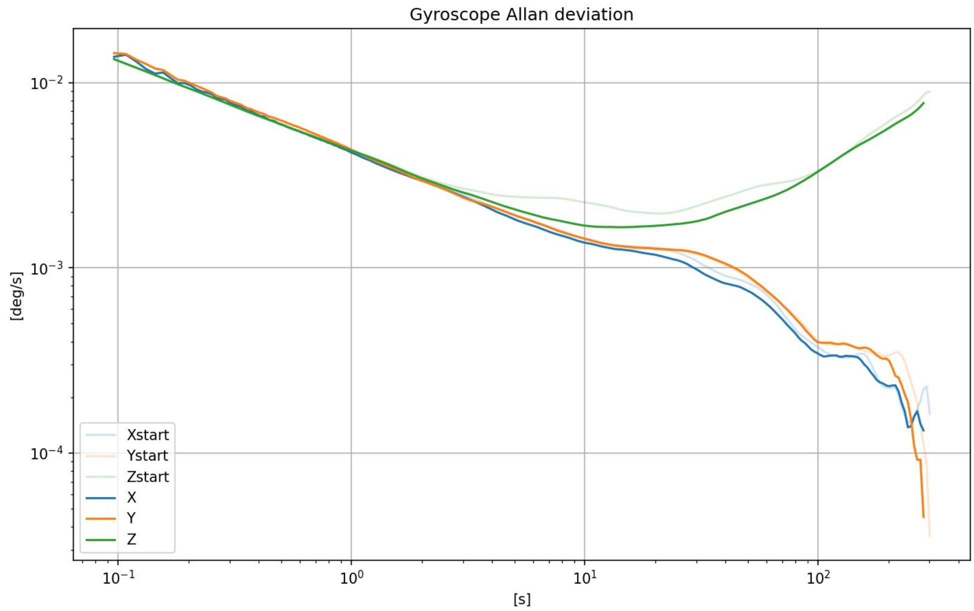
Statistics is collected for the gyroscope sensor in a leveled position with GNSS Off, magnetometer weight 1.0, temperature is stabilized.

- [Xstart, Ystart, Zstart] – just after system restart, when the filter settles.
- [X, Y, Z] – 30 seconds after the start.

GPS_IMU 1.x:



GPS_IMU Split:



Embedded sensors performance

	Accelerometer	Gyroscope	Magnetometer
Bias in-run instability	30 µg	11 °/h	
Random walk	600 µg/√Hz	0.22 °/√hr	1.5 mG RMS
Non-linearity	0.3 %	0.1 %	0.25 %
Bandwidth	218 Hz	250 Hz	125 Hz
Range	16 g	2000 °/h	16 G

Accuracy (RMS)

	Static, GNSS disabled	Static, GNSS enabled	Dynamic
Roll / Pitch	0.2 °	0.5 °	-
Heading by magnetometer	2 °	2 °	2 °