Bizclap Gyrocompass

BizGyro User Manual - **08/2025 update**

BizGyro®
User Manual

BizGyro

BizGyro - GNSS

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Bizclap S.r.l

1. Notices

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- Bizclap S.r.l reserves the right to make changes to this information without notice.
- Reproduction of this manual in whole or in part, by any means, is prohibited without obtaining prior permission from Bizclap S.r.l
- Bizclap S.r.l. would greatly appreciate being informed of any errors detected.

Labeling
The BizGyro/BizGyro-GNSS label permanently applied on the product displays: manufacturer name/brand (Bizclap S.r.l.), type designation, unique serial number, electrical data (supply voltage and power consumption), the unit's IEC 60945 environmental category, IP protection rating, and compass-safe distances (standard/steering) as determined during testing. The label layout and location are shown in the attached marking drawings.

Environmental Category
BizGyro/BizGyro-GNSS is classified in accordance with IEC 60945 § 4.4; the EUT category (Protected/Exposed) is stated for each model on the certificate and on the label, according to the intended onboard installation.

Software Information
The sensor firmware version and the PC software version are shown in the Control Panel Dashboard (information **"i"** icon) and are provided with screenshots in this manual; where required by the authority, these details are also referenced on the label/documentation.

2. In The Box

Thank you for purchasing BizGyro Motion Reference Unit (MRU) from Bizclap S.r.l.
Your Delivered Pack contains the following Items:

- BizGyro or BizGyro - GNSS
- Junction box
- Cable of 5m to 20m maximum length.
- Warranty Card.

Contents

3. Important Notes

In this manual the following remarks are used:

A ***caution*** *sign is used to make the user aware of procedures and operational practice to be followed in order to prevent any degrade in the performance and prevent any damage to the equipment.*

A **note** sign is used to draw users' attention to a special feature or behavior of the equipment.

A **tip** sign is used to give some extra information for advanced user setting.

4. Introduction

1.About this manual

This manual serves as the user guide for Inertial Measurement Unit (IMU) developed by Bizclap S.r.l

The motion sensors are being used in a wide range of applications, such as:

- Gimbals Systems stabilization in drones and UAV.
- Offshore oil & Gas industry.
- Hydro-graphic survey.
- Helideck monitoring Systems, crane monitoring systems.
- Active heave compensation systems (AHC) for marine applications.
- Robotics
- Smart agriculture and renewable energy.

All the motion sensors developed by Bizclap S.r.l use MCU processor with AI.
This solution offers a whole new level of real time performance and filtering excellence. The platform is taking advantage of real hardware circuitry, allowing extremely low latency measurements and estimation.

Needless to say BizGyro product family is armed with the full Bizclap arsenal of high quality hardware. These include the industrial serial ports, RS232, RS422, Ethernet, GNSS integration.

For further information, you can also visit our website or contact our info desk and at:

info@bizclap.eu
https:// www.bizclap.it

5. Definitions and abbreviations

1.Definitions

Alignment: The process of arrangement in a straight line or adjusting the internal frame (G, N or B-frame) in the instrument to the true external frame.

Attitude: The orientation relative to the vertical axis of a vehicle.

Heading: In navigation, the heading of a vessel or aircraft is the compass direction in which the craft's bow or nose is pointed.

Heave: The vertical dynamic motion of a vehicle. Heave position and velocity are dynamic motion variables with a certain low frequency.

Inclinometer: A sensor that measures the roll and pitch by measurement of the direction of the acceleration. Inclinometers provide correct readings when the vehicle is not subjected to any linear acceleration.

Pitch: A rotation about the pitch axis. Pitch also means the dynamic pitch angle motion.

Roll: A rotation about the roll axis. Roll also means the dynamic roll angle motion.

Starboard: When looking in the bow direction of a vehicle this is the right hand side of the vehicle.

Surge: The horizontal linear dynamic motion of a vehicle in the heading direction (along the Roll-axis) and defined positive for a forward motion.

Sway: The horizontal sideways dynamic linear motion of a vehicle (along the Pitch-axis) and defined positive for a motion to starboard.

Yaw: A rotation about the vertical axis. Yaw also means the dynamic yaw motion.

2.Abbreviations

AHRS: Attitude & Heading Reference System. An inertial system that measures the orientation of a vehicle.

b-frame: Body frame. An orthogonal frame fixed to the IMU housing or to the vehicle where the IMU is fixed.

CG: Center of gravity is the mass center of a vessel. This is the location with least linear acceleration, and hence the best location for measuring the roll and pitch.

DSP: Digital Signal Processor.

EMI: Electro-Magnetic Interference.

FPGA: Field Programmable Gate Array.

g-frame: Geographic frame. An orthogonal frame having axes pointing north, east and down at the current location of the vehicle.

IMU: Inertial Measurements UNIT- It is a unit that measures and reports a body's specific force, dynamic linear motion, angular rate, and sometimes the magnetic field surroundings the body, using a combination of accelerometers and gyroscopes, sometimes also magnetometers.

INS: Inertial Navigation System. A system consisting of gyros and accelerometers intended for navigational purposes.

MRU: Motion Reference unit. It is an alternative definition for inertial measurement unit with single- or multi-axis motion sensors. MRU – Motion Reference Unit are capable of measuring roll, pitch, yaw and heave.

NMEA: A standard for interchange of information between navigation equipment.

Pitch-axis: or Y-axis This axis is fixed in the vehicle, and points in the starboard direction horizontally when the roll angle is zero.

RMS: Root mean square.

RMSE: Root mean square error.

Roll-axis: or X-axis. This axis is fixed in the vehicle, and points in the forward direction horizontally when the pitch angle is zero.

Yaw-axis: or Z-axis. This axis is fixed in the vehicle, and points in the downward direction when the vehicle is aligned horizontally.

6. Technical Description and Specifications

The IMU contains 3-axis accelerometers and 3-axis gyroscopes and 3-axis optional magnetometers. The IMU calculations are performed using the latest cutting-edge Bizclap technology on an AI-enabled MCU, this unique sophisticated arrangement enables rapid and complex real-time computation. This computation relates to numerical integration, filtering and state space estimations.
The IMU outputs absolute roll, pitch and yaw, and relative heave (dynamic),
Linear Accelerations and velocities of the motions, as well as angular velocities.

Heave motion is estimated based on measurements from the accelerometers using an adaptive heave filter. Our custom **MCU with AI** guarantees high accuracy and no latency heave estimation.

The heave calculation output is a relative value, it can't be used to provide the absolute position of the vehicle.
The Yaw output suffers from continuous drift, as the magnetometers performance is not reliable in any ideal environment where EMI exists, and it is not used for drift compensation, hence particular care must be taken when using the yaw value without *GPS Aiding*.
The output parameters are presented in a digital output string via standard serial ports RS422 and RS232, and Ethernet UDP/IP or TCP/IP.

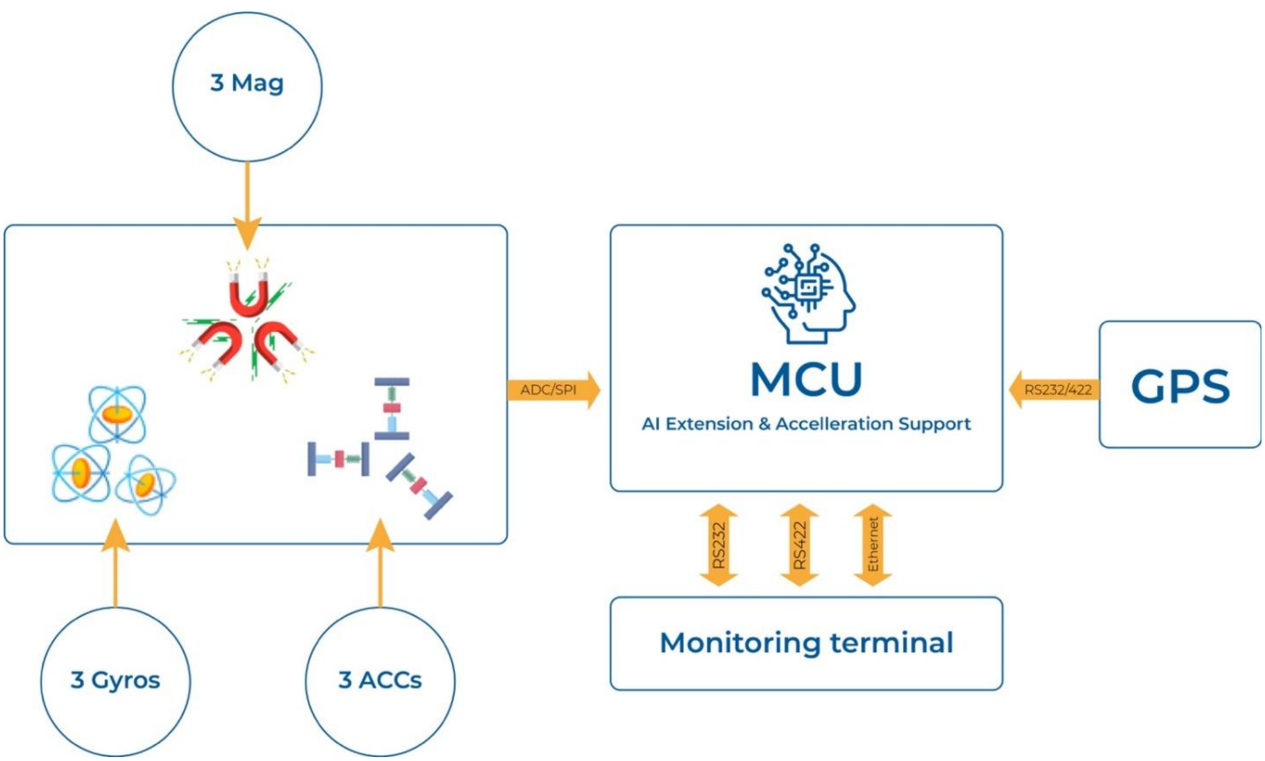


Figure 1: IMU block diagram

The IMU sensors can be customized in a variety of performances and prices to meet the customer's needs. Customization concerns software only (enabling/disabling parameters/protocols); hardware does not change.

1. IMU Applications

Typical output parameters of Motion sensors include, Roll, Pitch and Yaw angles, the angular rate vector, linear accelerations and linear displacement.
Heave Motion for marine applications, surge and sway motion in particular cases.

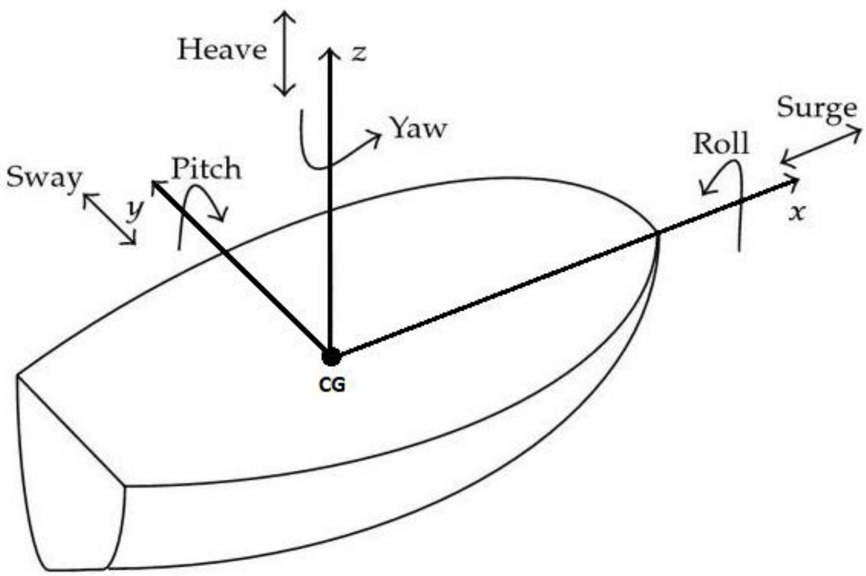


Figure 2

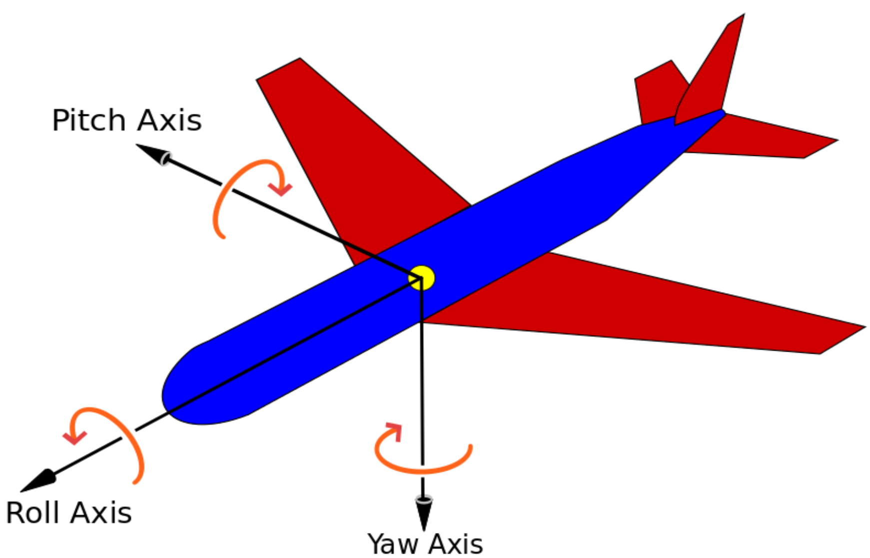


Figure 3

2.Mechanical interface

The BizGyro Family IMU is installed using four M6 screws (Aluminum, and Titanium Enclosures) on the base plate of the unit (see figure 4). T Orientation arrow is located on the bottom plate of the system. The arrow appears as groove on the base plate of the unit.

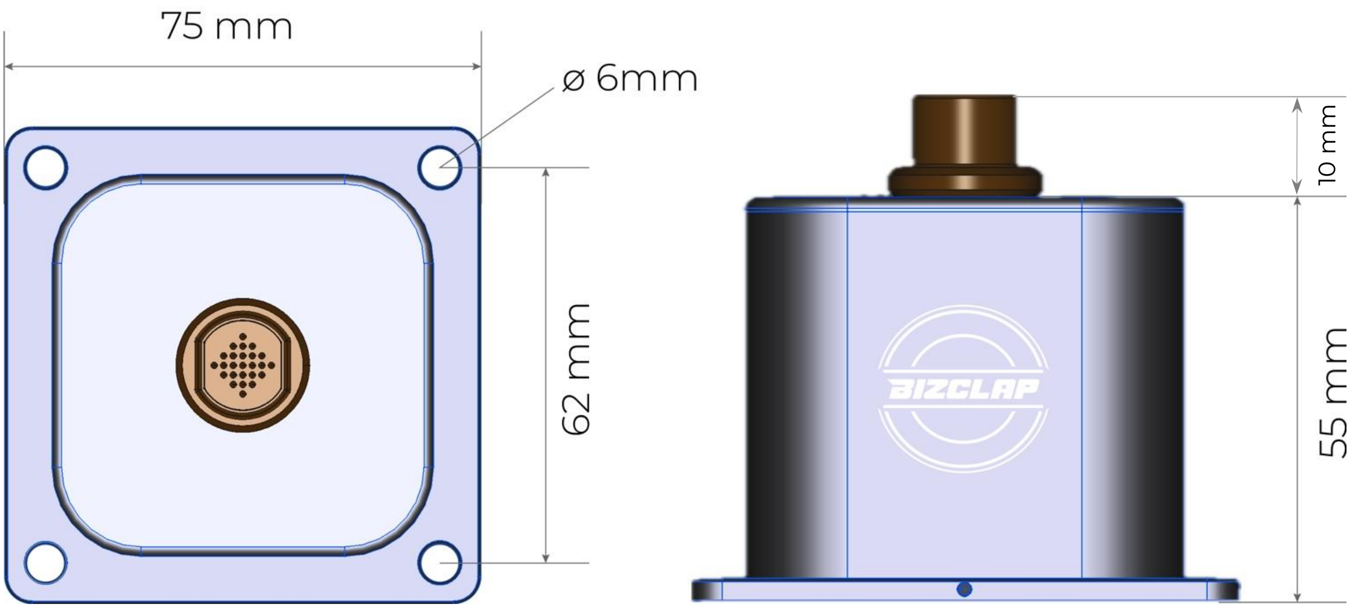


Figure 4 Mechanical Specifications

The connector shape could slightly differ between different batch or models and connector height only may vary by ± 5 mm, to suit customer integration needs.

3. Electrical Interface

All the BizGyro inputs/outputs are made via a 16-pin circular connector. The connectors are IP68 rated.

The 16-pin connector is used to provide the following:

1. Power supply inputs.
2. 1 Serial Input/output port (RS232).
3. 1 Serial Input/output port (RS422).
4. 1 Ethernet Rx and Tx channels.
5. 1 Extra Serial Input/output RS232.

Figure 5: pin layout

The pin layout of the connector is as described below:

Pin number	Signal	Pin number	Signal
1	V+	9	RS-422 Tx-
2	GND	10	RS-422 Rx+
3	DGND	11	RS-422 Rx-
4	RS-232 Tx1	12	Reserved
5	RS-232 Rx1	13	Eth Tx+
6	RS-232 Tx2	14	Eth Tx-
7	RS-232 Rx2	15	Eth Rx+
8	RS-422 Tx+	16	Eth Rx-

The physical pinout of the 16-pin connector is unique and shown in Figure 5. In customized configurations, certain pins may be disabled for application needs; for example, in an Ethernet-only configuration pins 13–14–15–16 may be deactivated.

4. Electrical & Hardware Specifications

	BizGyro	BizGyro-GNSS
Operating Voltage	6.5 to 36 V	6.5 to 36 V
Power Consumption	<1 W	<0,8 W
Operating Temperature	-25 °C to 70 °C	-25 °C to 70 °C
Environmental Protection	IP68	IP66
Shock Limit	1000 g	1000 g
Min Dimensions	7.5×7.5×5.5 cm	6.5×4.5×5 cm
Max Dimensions	7.5×7.5×6.5 cm	7.5×4.5×5 cm
Weight (approximately)	500 grams	250 grams

Too low- or high-voltage power or high noise surge voltage (exceeding the voltage limit) applied to the input circuit or Connecting the power supply in reverse polarity can cause malfunction or permanent damage to the device and therefore not covered by the warranty.

7. COMPUTATION OF HEAVE

Accurate heave measurements are extremely important in the application of marine field to actively compensate for wave motion of a ship.

1.Definition of heave

The heave, or vertical motion of the vessel, is determined by the double integration of the acceleration. The vertical acceleration measurement is subjected to bias due to the physical limitations of the MEMS accelerometers. Integrating the bias results in linear trend that cause the numerical double integration to quickly diverge to infinity. The typical solution, used almost in every motion sensor, is to use a high- pass filter, which cancels out the bias component. ***By definition, Heave is the vertical amplitude of a movement which is filtered to cut-off the frequency around zero.***

The definition clearly indicates that the heave is a dynamic position, and thus it can't represent the absolute position of the vessel.

2.Heave Specifications

In **BizGyro** family the heave motion is estimated based on measurements from the accelerometers using an adaptive heave filter. Our custom AI Processor guarantees high accuracy and no latency heave estimation.

Output range	±10 m
Period	1 to 25 s
Dynamic accuracy	5 cm or 5% whichever is highest

Since the heave calculation is subjected to band-pass filter, the heave output will always return to zero value when the Motion Sensor is standing still (static position). The heave filter is automatically configured, there is no need for the user to input any parameter.
Heave filter is initialized each time the sensor is re-started. The duration of the heave initialization phase depends on the frequency of the motion, and is roughly 4 times the period of the motion. Hence, heave delivers accurate value after a total initialization phase of roughly 1 minute.

3. Sign conventions

The Motion Sensor is defined by three axes, the first horizontal axis is the **X axis**, the second horizontal axis is the **Y axis**, and the vertical axis or **Z axis**.

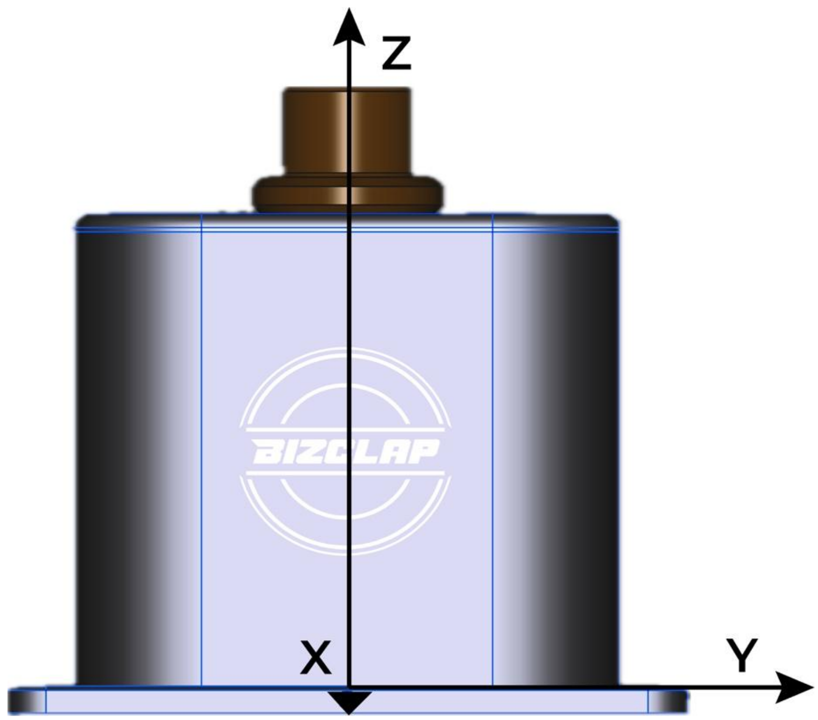


Figure 6: IMU coordinate system

The heave axis directions are defined as follows:

- The heave is by default defined positive up on a vertical axis **(Z axis)** pointing to the direction of the connector.
- The user can change the direction of the heave using the control panel software by ticking the **invert heave check box**.

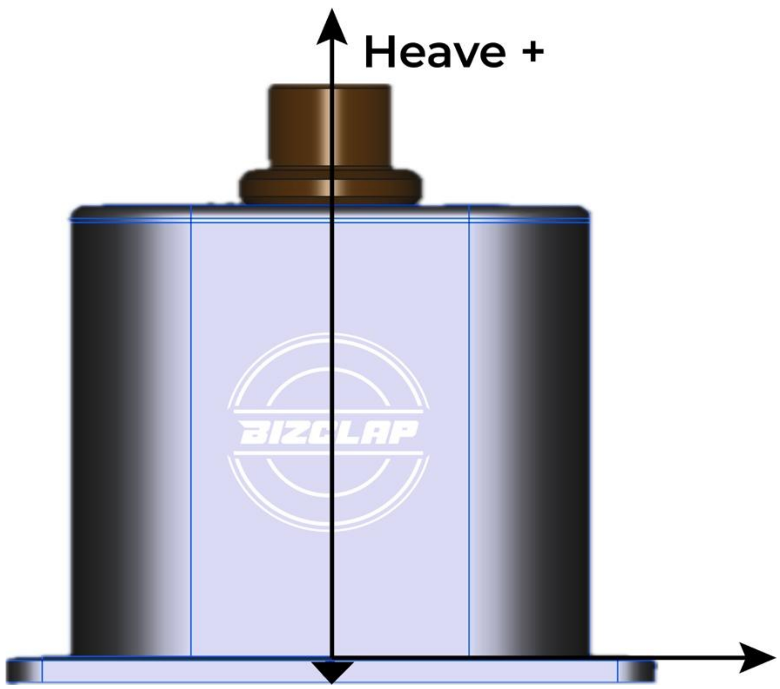
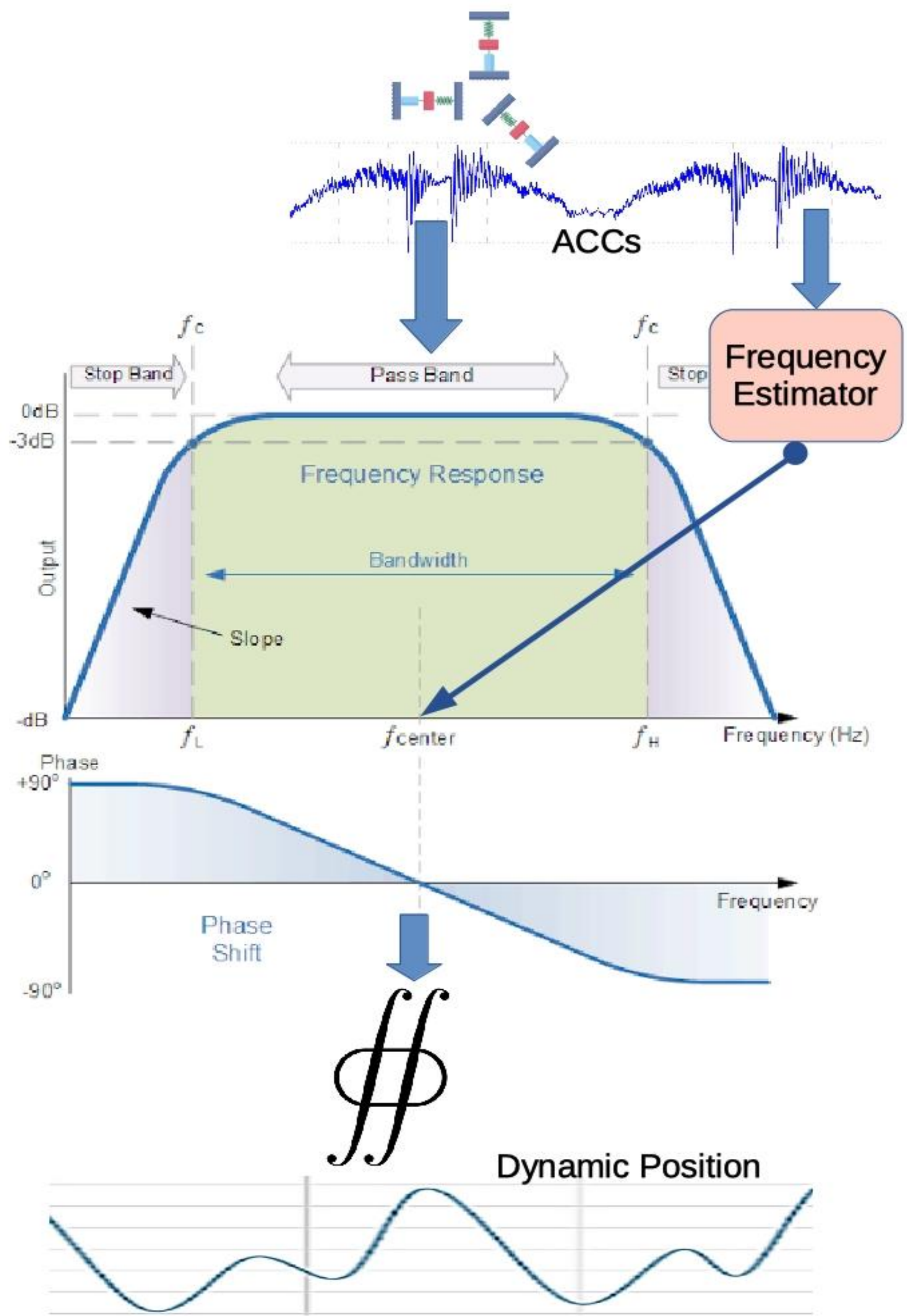


Figure 7 heave sign convention

4.Adaptive heave Algorithm

The heave calculation algorithm can be summarized in the following diagram:



5.Dynamic adaptive heave

A traditional adaptive heave model estimates one dominant frequency, thus for a complicated motion (that combines multiple frequencies) the performance of the period estimation degrades and the calculation error increase, to overcome this limitation, **Bizclap S.r.l** offers an **enhanced dynamic adaptive filter**, in this model heave parameter is automatically tuned to better adapt with the frequency.

The dynamic adaptive heave model is restricted to limited IMU sensor models, please contact Bizclap S.r.l for more information.

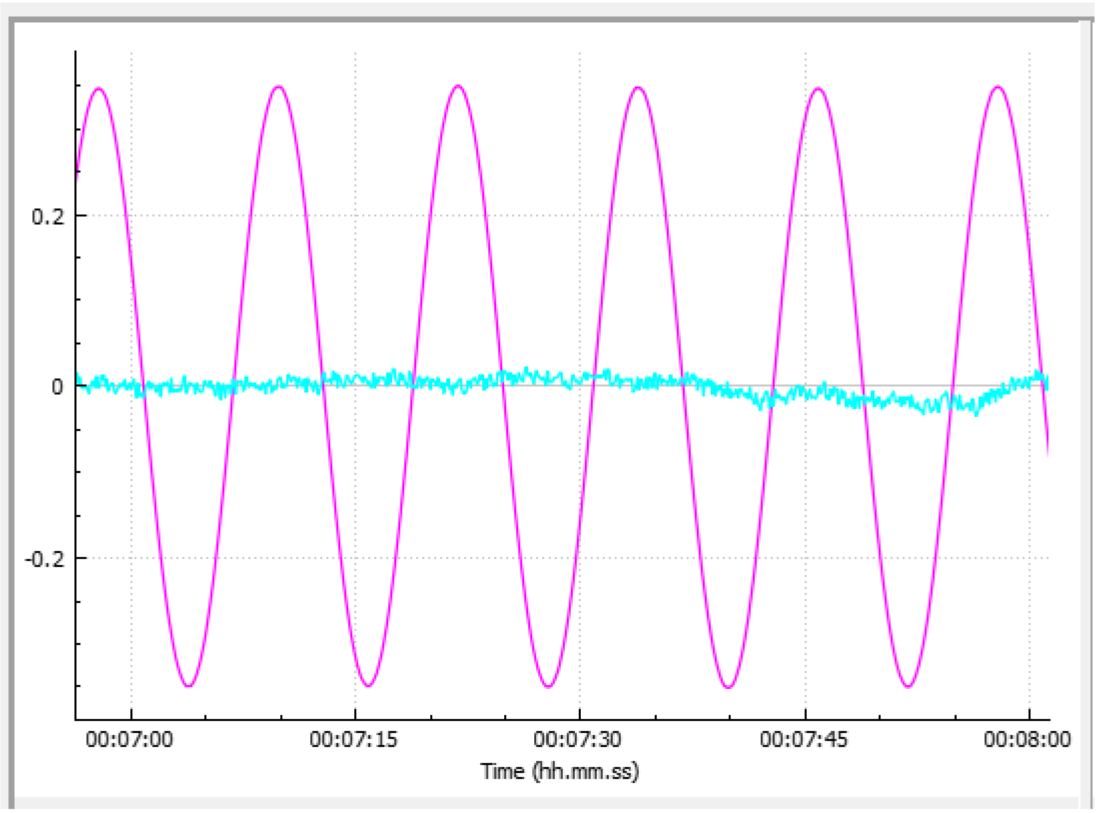


Figure 8: Example of a heave Motion

8. Roll, Pitch and Yaw

All the sign convention defined in the following section are the default definition by Bizclap S.r.l, the convention is user customized, and can be changed any time using the control panel software by ticking the **invert Roll/Pitch check box**, depending on his/her convenient.

1. Roll

The roll is the angle of rotation around the first axis of the IMU (**X axis**) and could be seen as the angle between the horizontal plane and the second horizontal axis of the Motion Sensor (**Y axis**).

This angle is default defined positive in the direction of **X axis**.

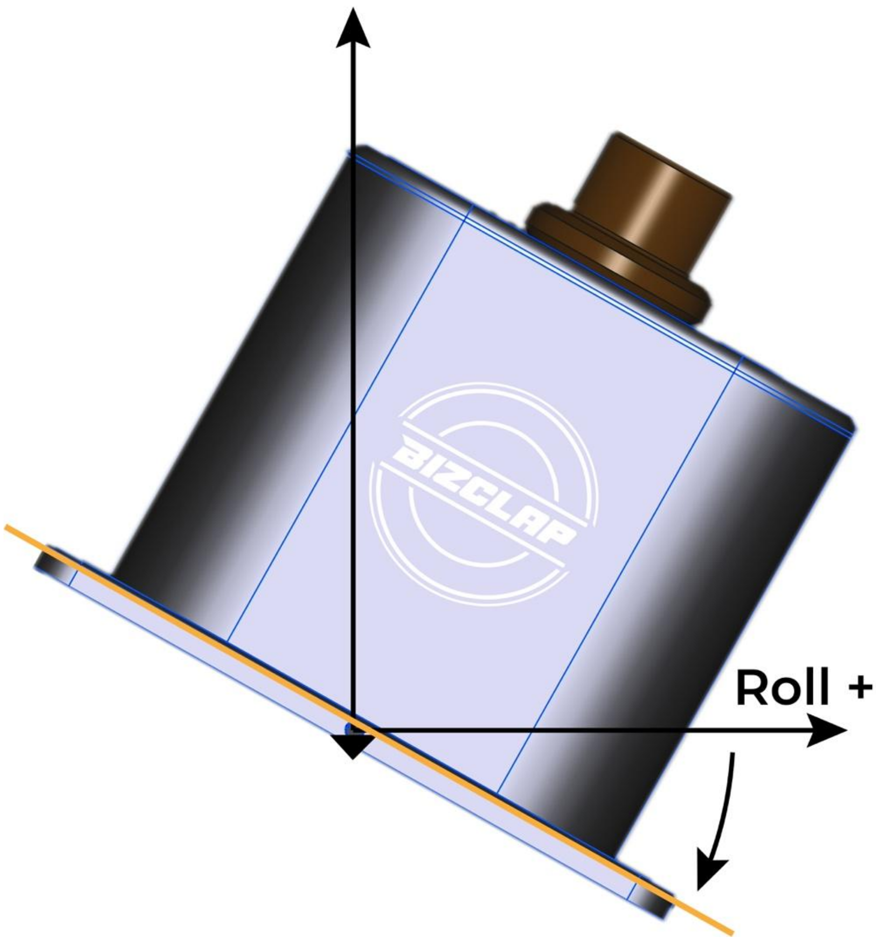


Figure 9: Definition of roll

Roll Specifications

Series	BizGyro	BizGyro - GNSS
Output range	±45 Degrees (±π/4 Radian)	
Static accuracy (rmse)	0.01 Degree	0.05 Degree
Dynamic accuracy (p2p)	0.1 Degree	1 Degree

2. Pitch

The pitch is the angle of rotation around the second axis of the IMU (**Y axis**) and could be seen as the angle between the horizontal plane and the first horizontal axis of the Motion sensor **(X axis)**.

By default, the Pitch angle is defined positive in the direction of **Y axis**.

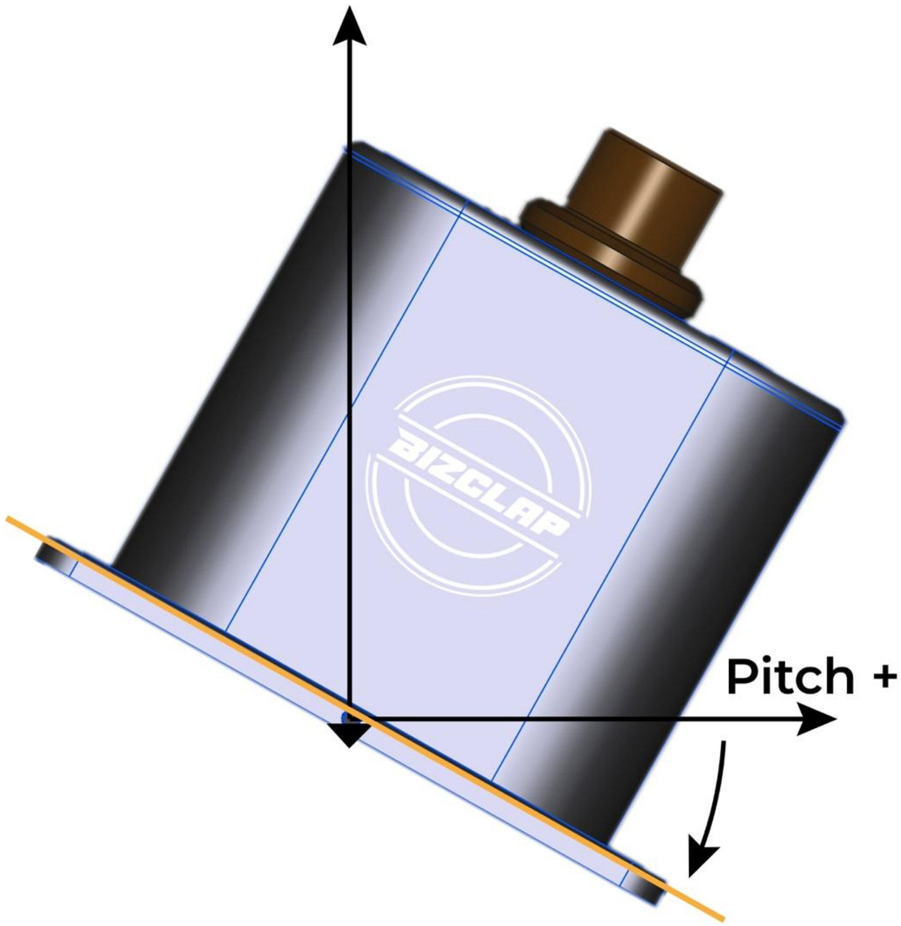


Figure 10: Definition of pitch

Pitch Specifications

Series	BizGyro	BizGyro - GNSS
Output range	±45 Degrees (±π/4 Radian)	
Static accuracy (rmse)	0.01 Degree	0.05 Degree
Dynamic accuracy (p2p)	0.1 Degree	1 Degree

3. Yaw

The Yaw angle is the angle of rotation around the vertical axis (**Z axis**) pointing to the direction of the connector.

The Yaw value alone is not the true heading which is the angle in the North direction and the vertical plane passing through the Motion Sensor.

The orientation of this angle is given in the following figure.

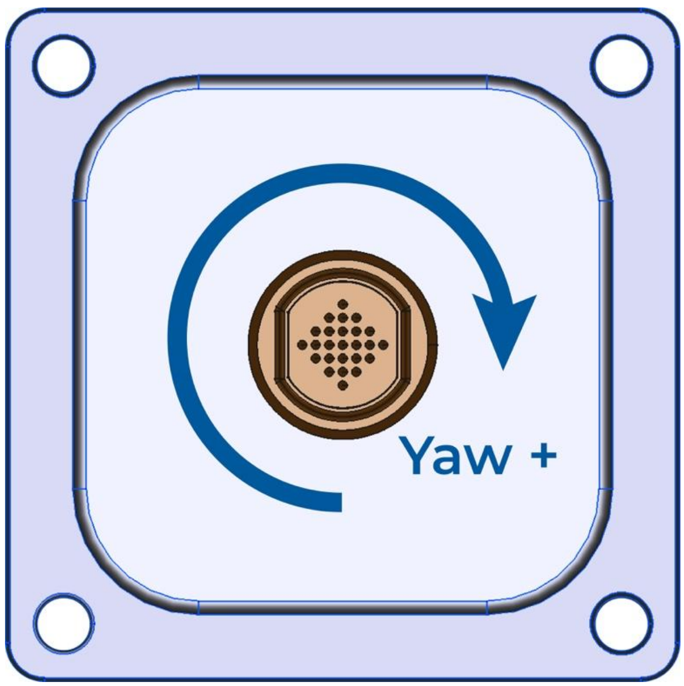


Figure 11: Definition of Yaw

Yaw Specifications

Output range	0-360 Degrees (2π Radian)
Static accuracy	NA due to gyro drift
Dynamic accuracy	0.05 Degree

9. Interfacing with the IMU

Bizclap S.r.l provides a simple and a user friendly IMU Control Panel Software, which uses the Serial Port or/and Ethernet for testing, configuration and logging with the IMU.

1. Serial Port Configuration

The Motion sensor output is compatible with the standard serial port protocols RS232 and RS422.

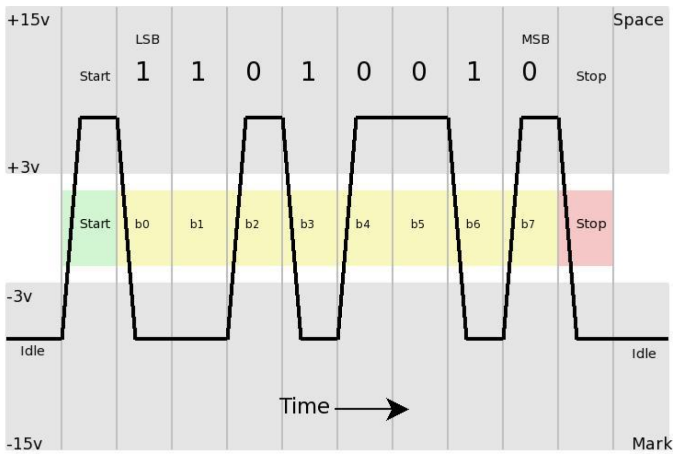


Figure 12: RS232 Port Signal Format

The customer can choose whether to manually configure the baud rate (transmission speed) or **Auto Scan** option then click on the connect buttons, the control panel software will search through all available ports and try to find IMU.

BizGyro family supports only <u>8bits data</u> width, <u>no parity</u>, <u>one stop bit</u>.

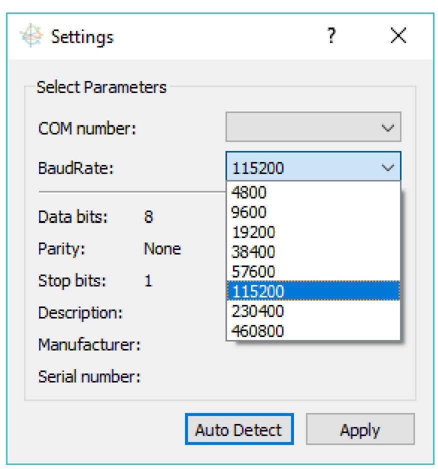


Figure 13: Serial Port Configuration

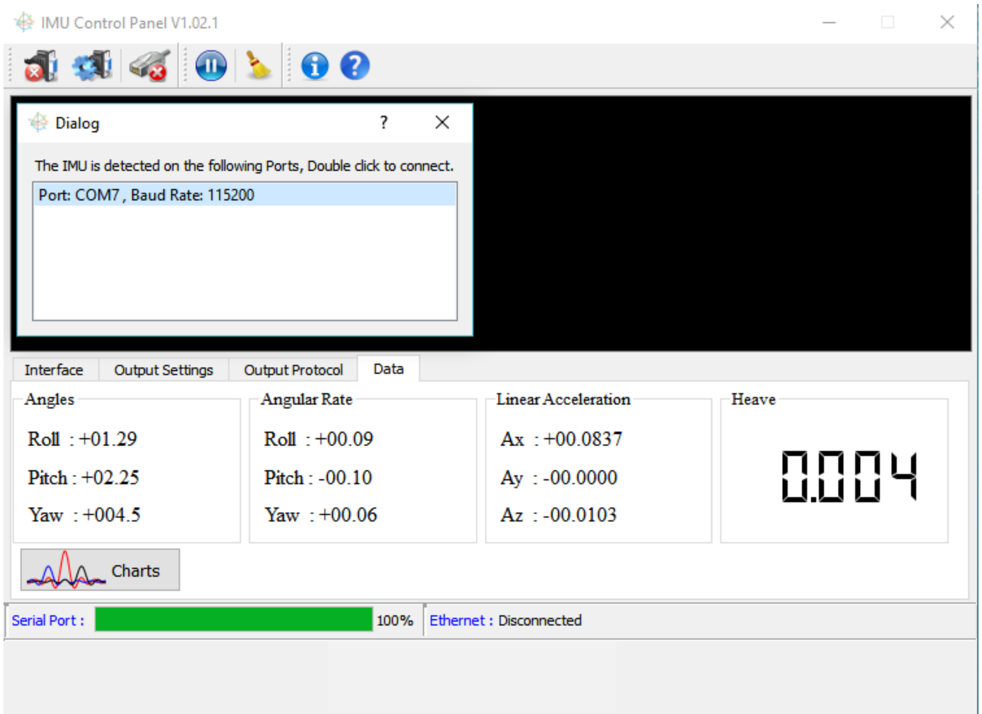


Figure 14: Auto Detect Serial Port

When the scanning is successfully done, the control panel reads and displays all the IMU settings and parameters.

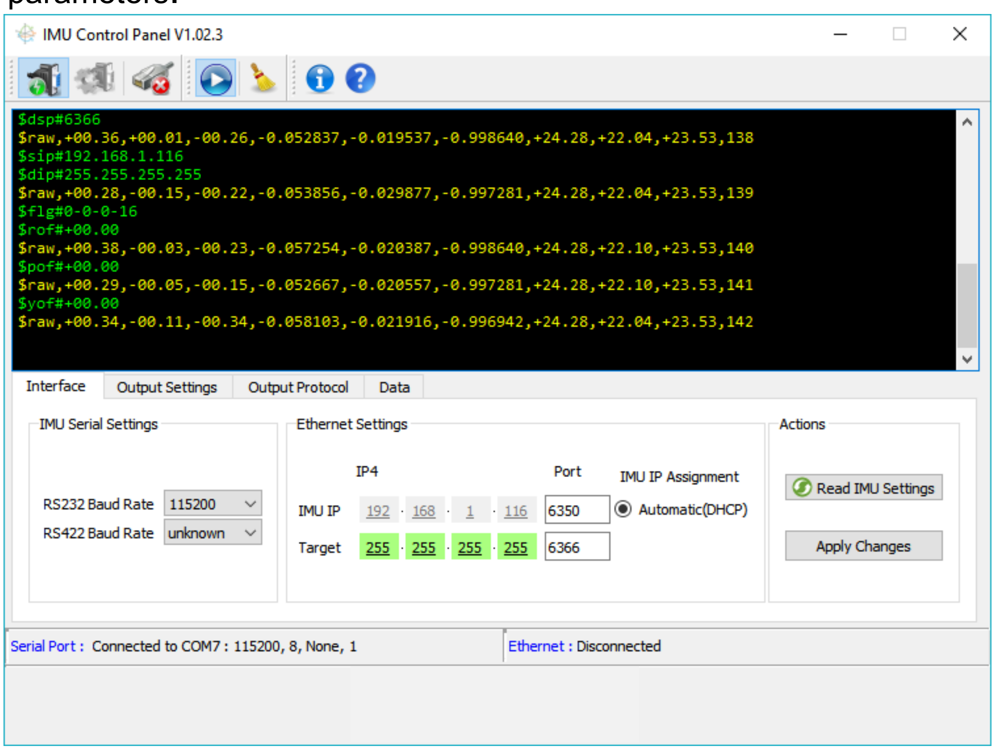


Figure 15: Control Panel Interface

2.Ethernet Configuration

BizGyro product family is ***Ethernet capable sensor***, the Motion sensor is fully compatible with the Ethernet protocol version 4 (**IP4**).

BizGyro product family supports **DHCP** protocol which provides Dynamic or Automatic IP4 address assignment.

When using the control panel, there is no need to specify the IP or the port number to initialize the communication with the sensor, the control panel will just scan the network find the IMU and display all the information. Then the user is free to configure the desired destination port number, IMU port number, destination IP address and the IMU IP address.

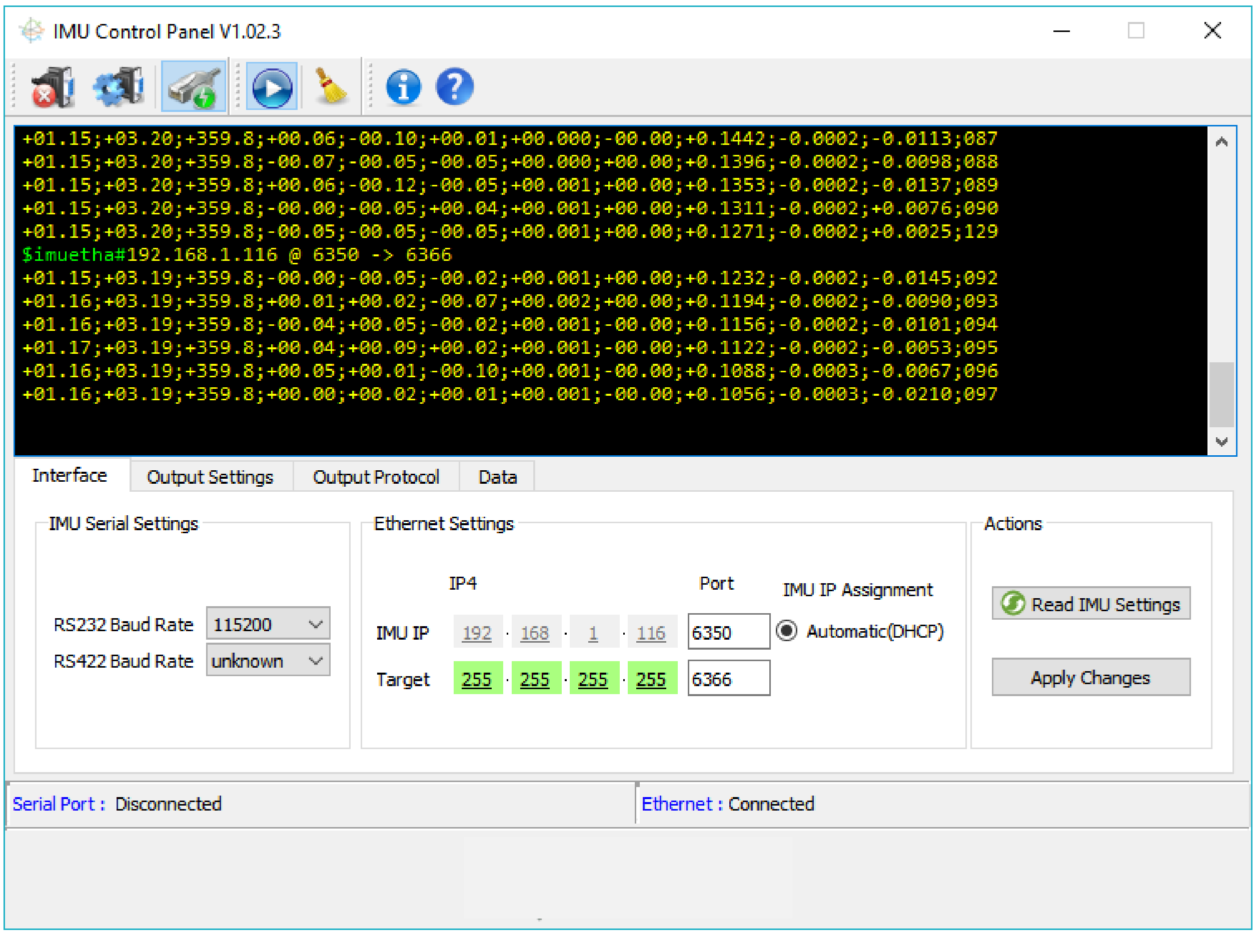


Figure 16: Control Panel Ethernet Interface

10. Output Data Format

The Output Protocol tab in the control panel allows the user to configure the output string format, just tick the checkbox next to the desired parameter name, then click the Apply button. The sensor Talker ID is displayed in the Dashboard (Output Protocol tab) and can be referenced in the certificate where required. The unit can interface with systems that accept NMEA 0183 or UDP inputs.

The customized output protocol option is applicable only for Standard Serial Port output, the Ethernet output uses binary format, and transmit all the parameters at once using UDP packet.

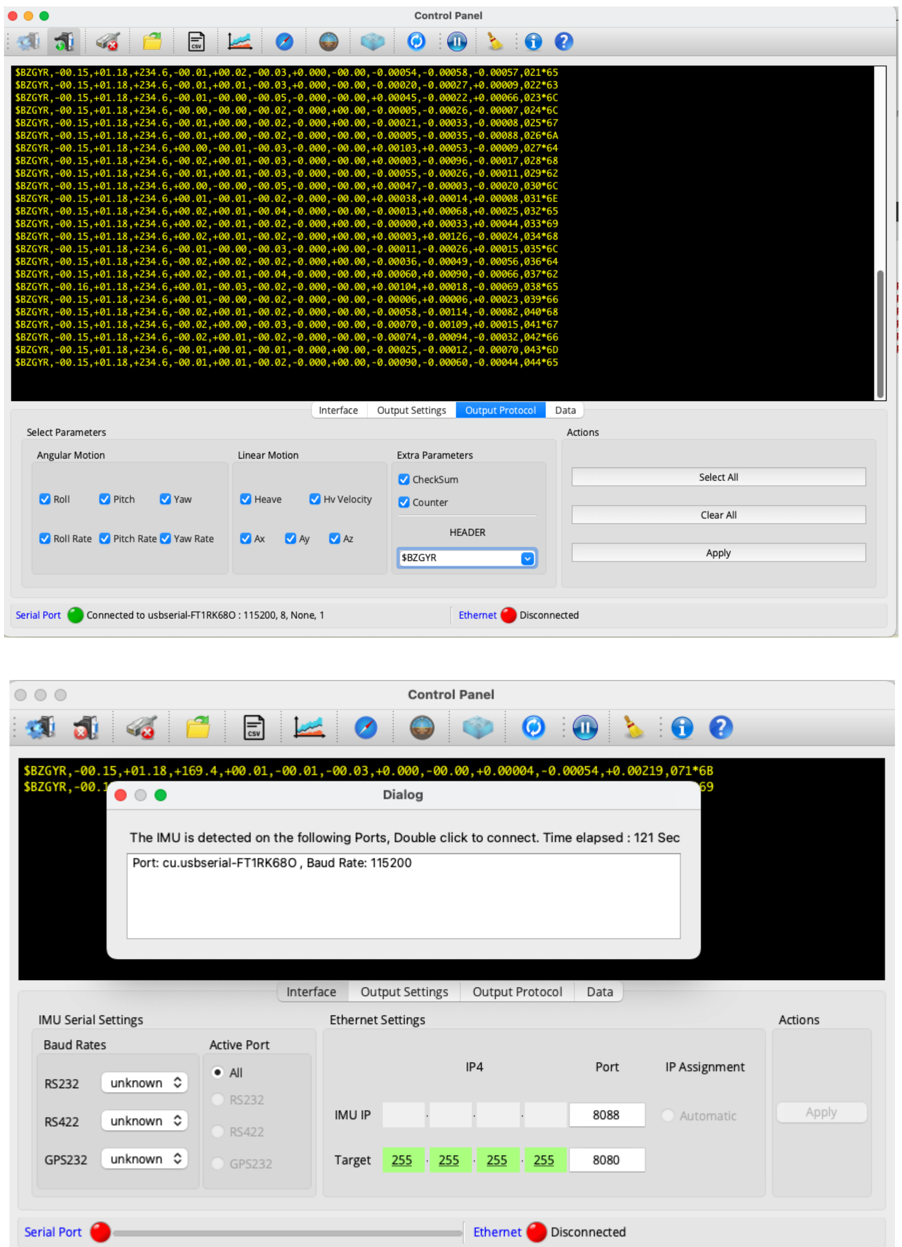


Figure 17: Output Protocol Configuration and Talker ID

1. Serial Output String Format

The motion sensor output message follows The NMEA standard that uses a simple ASCII serial communications protocol.
The control panel provides more flexible output string format in order to better satisfy the customer's needs.

BizGyro allows access to the raw data of its core sensors "if needed contact Bizclap S.r.l".

2. Message structure (NMEA Standard)

- All transmitted data are printable ASCII characters between 0x20 (space) to 0x7e (~).
- Data characters are all the above characters less the reserved characters.
- Reserved characters are used by NMEA0183 for the following uses:

ASCII	Hex	Dec	Use
<CR>	0x0d	13	Carriage return
<LF>	0x0a	10	Line feed, end delimiter
!	0x21	33	Start of encapsulation sentence delimiter
$	0x24	36	Start delimiter
*	0x2a	42	Checksum delimiter
,	0x2c	44	Field delimiter
\	0x5c	92	TAG block delimiter
^	0x5e	94	Code delimiter for HEX representation of ISO/IEC 8859-1 (ASCII) characters
~	0x7e	126	Reserved

- Messages have a maximum length of 82 characters, including the **$** or **!** starting character and the ending <**LF**>.
- The start character for each message can be either a **$** (For conventional field delimited messages) or **!** (for messages that have special encapsulation in them).
- The next five characters identify the talker (two characters) and the type of message (three characters).
- All data fields that follow are comma-delimited.
- Where data is unavailable, the corresponding field remains blank (it contains no character before the next delimiter).
- The first character that immediately follows the last data field character is an asterisk, but it is only included if a checksum is supplied.
- The asterisk is immediately followed by a checksum represented as a two-digit hexadecimal number. The checksum is the bit wise **exclusive OR** of ASCII codes of all characters between the **$** and *****. According to the official specification, the checksum is optional for most data sentences, but is compulsory for RMA, RMB, and RMC (among others).
- **<CR><LF>** ends the message.

3. Configure the output protocol using the control panel

When using the control panel for configuring the output string. You need to go to the Output Protocol tab, in this tab there are three groups (Angular Motion, Linear Motion and Extra Parameters). To setup your desired output protocol just tick on check box next to the parameter name.

The order priority of the output parameters is shown in the following table.

Group	Parameter	Priority
Header	Message Header	0 (high priority)
Angular Motion	Roll	1
	Pitch	2
	Yaw	3
	Roll Rate	4
	Pitch Rate	5
	Yaw Rate	6
Linear Motion	Heave	7
	Heave Velocity	8
	Ax	9
	Ay	10
	Az	11
Extra Parameters	Counter	12
	Check Sum	13(low priority)

The order of the parameters follows the order of the group and the parameter's order inside the group, the groups order starts from left to right, the group to the left got higher priority than the group to the right, the same rule applies for the parameter's order inside the group, the parameters in the first row have higher priority than the parameters in the second row inside each group.

The control panel allows to add a Header. The Header has the highest priority among all the other parameters in the output message.

The choice of the Header is fully customized, you can choose any character you prefer.

The Header maximum length is 8 characters

Example, if the following output parameters are enabled:

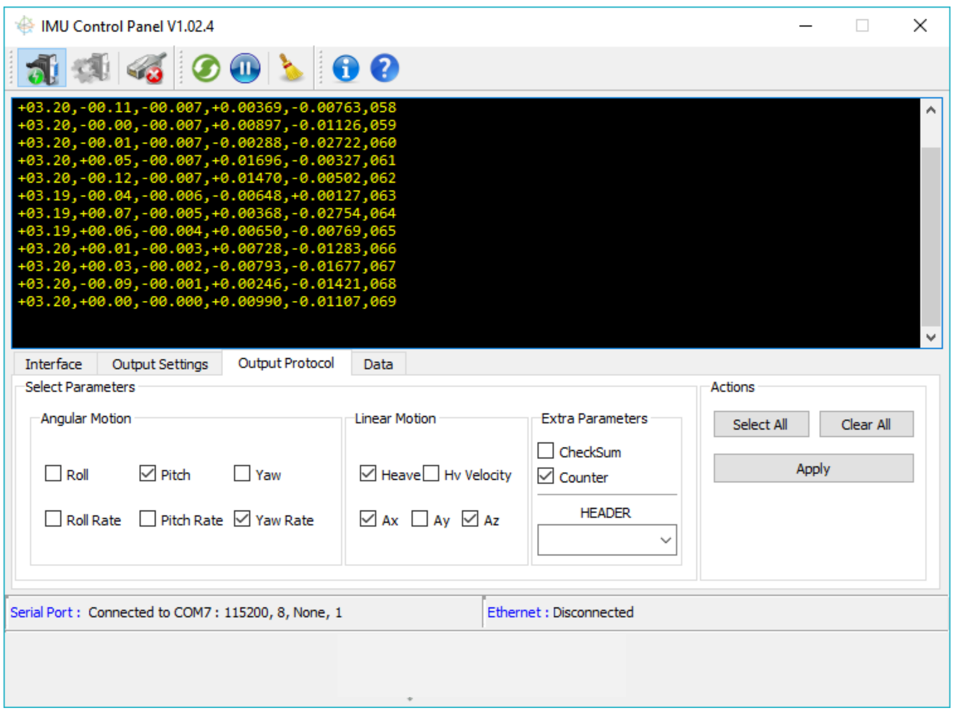


Figure 18: output protocol Format Example

The output stream order would be as the form below:

Pitch, Yaw Rate, Heave, Ax, Az, Counter

4. Check Sum Generation

The checksum is the bit-wise exclusive OR **(XOR)** of ASCII codes of all characters between the $ and *, The following **C code** generates and return a checksum for the string entered as "str".

```
int checksum(const char *str){
   int cs = 0;

   while(*str)
      cs ^= *str++;

   return cs;
}
```

Here is an example of packet with the generated check sum:

$hdr,+00.81,+03.16,-000.2,+00.001,+0.00665,-0.00841,+0.01024,035*7C

5. Standard output protocols

BizGyro product family supports standard output protocols; those protocols are listed below:

1. TSS1

TSS1 Protocol for Heave, Roll and Pitch

Message Format:

:XXAAAASMHHHHQMRRRRSMPPPP<CR><LF>

Field	Field Type	Description	Symbol	Example
1	TSS1 Header	Start of Packet Character	:	3A Hex
2	Horizontal Acceleration	Horizontal acceleration from 0 to 9.81m/s^2. Shown as a one byte unsigned hex number where the least significant bit = 3.83 cm/s^2.	XX	00
3	Vertical Acceleration	Vertical acceleration from -20.48 to +20.48 m/s^2. Shown as a two byte hex number where the least significant bit = 0.0625 cm/s^2.	AAAA	FFD5

4	Space Character	A space delimiter.	S	
5	Heave Polarity	Space if positive. Minus sign (-) if negative.	M	-
6	Heave	Heave value from -99.99 to +99.99 m. Shown as a four digit integer where the least significant bit = 0.01 m.	HHHH	0005
7	Status Flag	U,G,H,F (**see TSS1/TSS3 Status Flag Table below**).	Q	F
8	Roll Polarity	Space if positive. Minus sign (-) if negative.	M	-
9	Roll	Roll value from -99.99 to +99.99 degrees. Shown as a four digit integer where the least significant bit = 0.01 degrees.	RRRR	0213
10	Space Character	A space delimiter.	S	
11	Pitch Polarity	Space if positive. Minus sign (-) if negative.	M	
12	Pitch	Pitch value from -99.99 to +99.99 degrees. Shown as a four digit integer where the least significant bit = 0.01 degrees.	PPPP	0129
13	[CR][LF]	Carriage Return, Line Feed, Sentence terminator	<CR><LF>	

TSS1 Example:
:00FFD5 -0005H 0213 0129

The control panel allows the user to easily configure the standard TSS1 protocol using the Protocol/Header combo box drop down menu, here is how the output looks like when the TSS1 is configured as the output string.

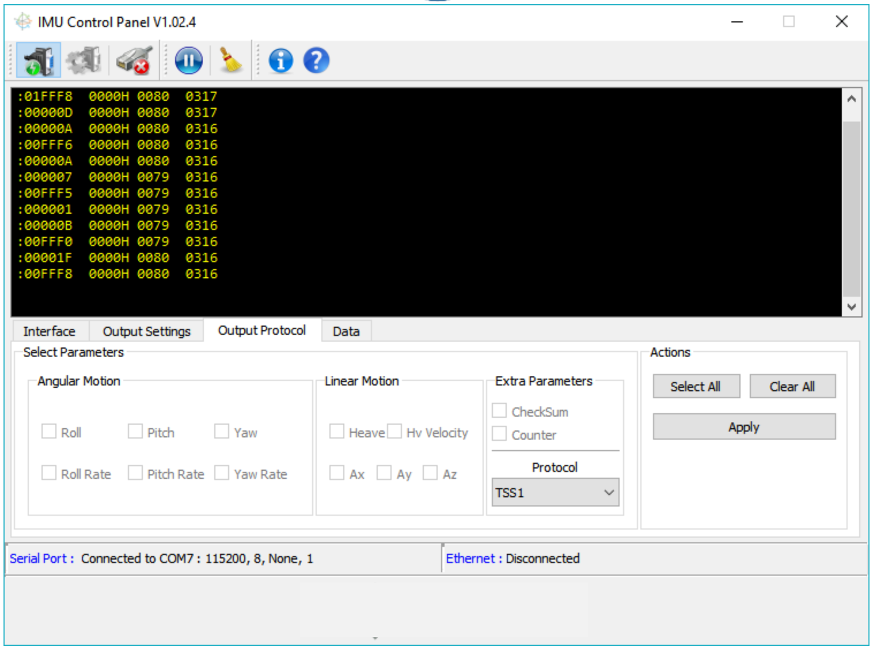


Figure 19: TSS1 Standard Protocol

When a standard output string (TSS1, TSS3, …etc.) is selected, the control panel will not allow access to the parameters check-boxes, to go back to a different custom protocol the user shall first change the Protocol/Header drop down select menu to Custom.

2. TSS3

TSS3 Protocol for Remote Heave, Roll and Pitch

Message Format:

:RMhhhhSMHHHHQMRRRRSMPPPP<CR><LF>

Field	Field Type	Description	Symbol	Example
1	TSS3 Header	Start of Packet Character	:	3A Hex
2	R	Identifies the string as TSS3 remote heave format.	R	
3	Remote Heave Polarity	Space if positive. Minus sign (-) if negative.	M	-
4	Remote Heave	Remote heave value from: -99.99 to +99.99 m. Shown as a four digit integer where the least significant bit = 0.01 m.	hhhh	0001
5	Space Character	A space delimiter.	S	
6	Heave Polarity	Space if positive. Minus sign (-) if negative.	M	-

7	Heave	Heave value from -99.99 to +99.99 m. Shown as a four digit integer where the least significant bit = 0.01 m.	HHHH	0005
8	Status Flag	U,G,H,F (**see TSS1/TSS3 Status Flag table below**).	Q	F
9	Roll Polarity	Space if positive. Minus sign (-) if negative.	M	-
10	Roll	Roll value from -99.99 to +99.99 degrees. Shown as a four digit integer where the least significant bit = 0.01 degrees.	RRRR	0213
11	Space Character	A space delimiter.	S	
12	Pitch Polarity	Space if positive. Minus sign (-) if negative.	M	
13	Pitch	Pitch value from -99.99 to +99.99 degrees. Shown as a four digit integer where the least significant bit = 0.01 degrees.	PPPP	0129
14	[CR][LF]	Carriage Return, Line Feed, Sentence terminator	<CR><LF>	

TSS3 Example:
:R 0001 -0005H 0213 0129

3. TSS1/TSS3 Status Flag

Status Flag	Description
U	"Unaided mode – settled condition" the IMU is operating without input from a GPS or gyro-compass sensor
G	"GPS aided mode – settled condition" The IMU is receiving input from a GPS sensor.
H	"Heading aided mode – settled condition " The IMU is receiving a heading input from a gyro-compass or GPS.
F	"Full aided mode – settled condition" The IMU is receiving inputs from a GPS and gyro-compass.

Standard NMEA protocols, TOGS, ISHPR, EulerB and EulerL are also supported.

Example of the TSS3 output from the motion sensor:

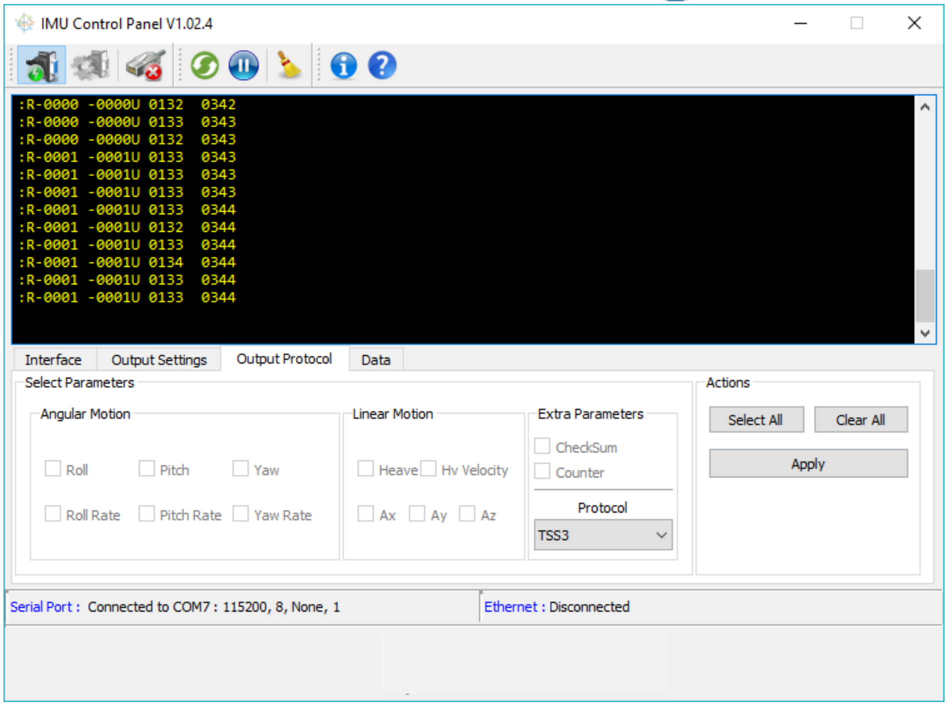


Figure 20: TSS3 Standard Protocol

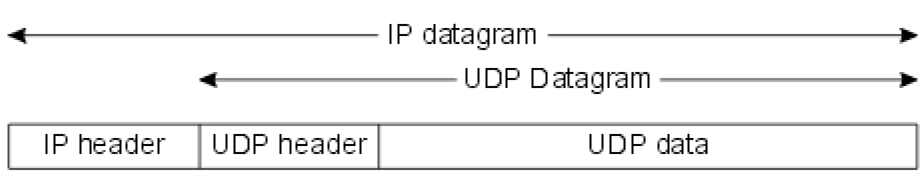
11. Ethernet Output

The Motion sensor supports only **Internet Protocol Version** 4 or (**IP4**), the Motion Sensors' IP address can be assigned directly (Static IP address) or Automatically using the **DHCP** protocol which provides Dynamic or Automatic IP4 address assignment.

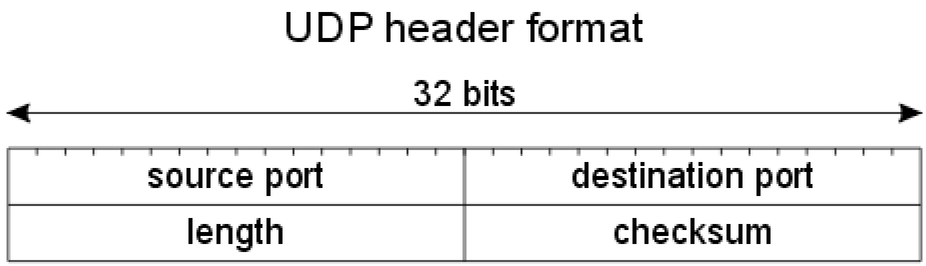
The Motion Sensor is capable of broadcasting or uni-casting to specific target IP address. The Sensor uses the **User Datagram Protocol** (**UDP**) which is one of the core members of the Internet protocol suite The protocol is **formally defined in RFC 768**.

With UDP, the Motion Sensor is capable of sending messages, in this case referred to as datagram, to other hosts on an Internet Protocol (IP) network.

1. Packet Structure/Format



UDP encapsulation



User Datagram & Header Format

The UDP header consists of 4 fields, each of which is 2 bytes (16 bits). The use of the checksum and source port fields is optional in IPv4.

Checksum is the 16-bit one's complement of the one's complement sum of a pseudo header of information from the IP header, the UDP header, and the data, padded with zero octets at the end (if necessary) to make a multiple of two octets.

For more information about the standard definition of the UDP protocol it is very recommended to refer to the RFC 768 definition by The *IETF*, the premier Internet standards organization.

2. Datagram Format

The Motion sensor broadcast the datagram in binary format, the standard representation is **Fixed-point arithmetic**, in particular the 16 bits fixed points notation.
a **fixed-point number** representation is a real data type for a number that has a fixed number of digits after and before the radix point **'.'**.
for example, if the Roll Angle Value is equal to **1.23** Degree, it will be represented as **80609** or (**0x13ae1**) in a 16 bits' fixed-point data type representation.
At the receiver point, the original real value can be obtained from the transmitted binary value with scaling factor of **1/ 65536**.

80609/65536 = 1.23 Degree

Unlike floating-point data types, the scaling factor is the same for all values of the same type, and does not change during the entire computation.
This representation requires 16 bits to represent the integer part of the real number and another 16 bits for the fractional part, hence the representation requires 4 bytes in the UDP datagram for each parameter.
The positive numbers are represented as normal positive integer values; the negative numbers are represented as **two's complement integer** values.
The Motion Sensor broadcast all the available parameters in one UDP packet using the notation mentioned before.

The bytes transmission order is most significant **byte** first, also abbreviated **MSBF**, **MSB** is the byte in a multiple-byte word (4 bytes in our case) with the largest value. As with bits, the MSB (byte) is normally the byte farthest to the left, or the byte transmitted first in a sequence.
The motion sensor broadcast the output parameters in the following order:

parameter	**Header**					
Byte offset	0-7					
parameter	Roll	Pitch	Yaw	Roll Rate	Pitch Rate	Yaw Rate
Byte offset	8-11	12-15	16-19	20-23	24-27	28-31
parameter	**Heave**	**Heave Velocity**	**Ax**	**Ay**	**Az**	**Reserved**
Byte offset	32-35	36-39	40-43	44-47	48-51	52-end

NOTE: bytes offset starts from the beginning of the UDP packet datagram, this means that the UDP header and IP header are not counted.

The packet length is constant, here is an example for the **datagram offset** and format, the reserved bytes offsets is grayed out.

Address(hex)	**data offset**
0000	**24 68 64 72 00 00 00 00**
0008	**00 00 ce ad ff fc e8 e2 01 64 15 0c ff ff f4 ef**
0018	**00 00 00 00 00 00 0c 25 00 00 00 88 00 00 00 04**
0028	**00 00 1a 96 00 00 00 02 00 00 01 18 00 00 00 00**
0038	**12 34 56 90 00 00 00 00 c0 40 00 00 c0 6c 00 00**
0048	**c0 60 00 00 00 00 00 00 00 00 00 00 00 00 00 00**
0058	**00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00**
0068	**00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00**
0078	**00 00 00 00 00 00 00 00 00 00 00 3d ca fe da ce**

Extracting the real values of the parameters can be done like the following procedure:

Header = 0x24 68 64 72 00 00 00 00 = “$hdr” (ascii).

Roll Fixed16=0x0000cead= 52909

Roll Value = 52909/65536.0 = 0.807 Degree

Pitch Fixed16 = 0xfffce8e2 = -202526 (Two's complement)

Pitch Value = -202526/65536.0 = -3.09 Degree

Heave Fixed16 = 0x00000088 = 136

Heave Value = 136/65536.0 = 0.002 m

Ay Fixed16 = 0x00000002= 2

Ay Value = 2/65536 ≈ 0 m/s^2

for deep inspection, and troubleshooting, It is recommended to use network protocol analyzer such as Wireshark which lets the user see what's happening on the network at a microscopic level.

Here is a screenshot of the output UDP packet using Wireshark.

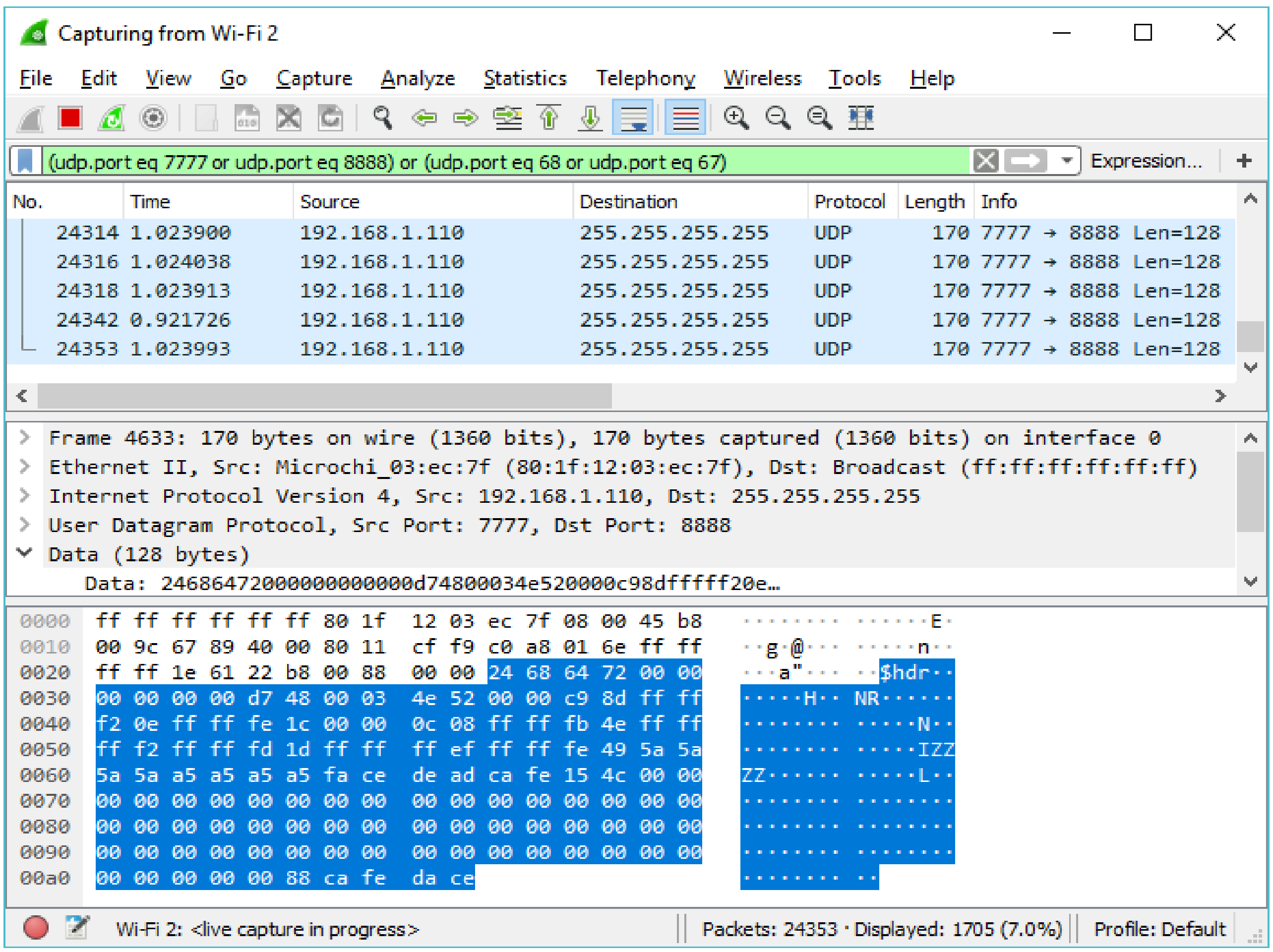


Figure 21 UDP packet Datagram

12. External Input Signals

The motion sensor is capable of reading standard format messages from external sources, such as GNSS signals or compass messages. The Motion sensor uses some of the information to Optimize the heading calculation.

- **Any Serial port input in the Aurora Family is capable of reading the external message, if your NMEA 0183-compliant device has only one transmitting wire (Tx), then use any of the (RS232) serial port in the Motion sensor, if your NMEA 0183-compliant device supports differential output (RS422), then you can use the RS422 Port of the motion sensor.**

The sensor accepts standard **NMEA 0183** sentences (e.g., **RMC, HDT, HDG/HDM, HSC, VHW, VTG, ZDA**). As inputs, all **standard-compliant talkers** are accepted, provided the sentence **starts with "$"** followed by **five characters** (talker identifier + message type). The supported messages are listed below.

- NMEA **RMC** or Recommended Minimum Navigation Information

  Message format:

  $--RMC,hhmmss.ss,A,llll.ll,a,yyyyy.yy,a,x.x,x.x,xxxx,x.x,a*hh

  1) Time (UTC)
  2) Status, V = Navigation receiver warning
  3) Latitude
  4) N or S
  5) Longitude
  6) E or W
  7) Speed over ground, knots
  8) Track made good, degrees true
  9) Date, ddmmyy
  10) Magnetic Variation, degrees
  11) E or W

- NMEA **HDT** or Heading True

  Message format: $--HDT,xx.xx,T*hh

  1) heading in degrees
  2) True

- NMEA **HDG** - Heading, Deviation & Variation

Message format: $--HDG,x.x,x.x,a,x.x,a*hh

1) Magnetic Sensor heading in degrees
2) Magnetic Deviation, degrees
3) Magnetic Deviation direction, E = Easterly, W = Westerly
4) Magnetic Variation degrees
5) Magnetic Variation direction, E = Easterly, W = Westerly

- NMEA **HDM** - Heading, Deviation & Variation

Message format: $--HDM,x.x,M*hh

1) Heading Degrees, magnetic
2) M = magnetic

- NMEA **HSC** - Heading Steering Command

Message format: $--HSC,x.x,T,x.x,M,*hh

1) Heading Degrees, True
2) T = True
3) Heading Degrees, Magnetic
4) M = Magnetic

- NMEA **VHW** - Water Speed and Heading

Message format: $--VHW,x.x,T,x.x,M,x.x,N,x.x,K*hh

1) Degrees True
2) T = True
3) Degrees Magnetic
4) M = Magnetic
5) Knots (speed of vessel relative to the water)
6) N = Knots
7) Kilometers (speed of vessel relative to the water)
8) K = Kilometers

- NMEA **VTG** - Track Made Good and Ground Speed

  Message format: $--VTG,x.x,T,x.x,M,x.x,N,x.x,K*hh

  1) Track Degrees
  2) T = True
  3) Track Degrees
  4) M = Magnetic
  5) Speed Knots
  6) N = Knots
  7) Speed Kilometers Per Hour
  8) K = Kilometers Per Hour

- NMEA **ZDA** - UTC, day, month, year, and local time zone.

  Message format: $--ZDA,hhmmss.ss,dd,mm,yyyy,xx,xx*hh

13. Usable Configuration

Roll & Pitch maximum range must be respected in order to get accurate information from the Motion Sensor.

All BizGyro IMU units, are designed as a standard for use on a vertical configuration. This means, mounting the sensor upside-down will result in a bad calculations.

14. Inertial Measurement Unit & Inertial Reference System

In fact, a single gyroscope measures the projection of the instantaneous angular rotation around its main axis, and three gyroscopes are necessary to measure the 3D rotation rate vector.

An accelerometer measures the instantaneous linear acceleration along a given axis (and thereby, through successive integration, speed and position), are calculated.

The 3 axes of the **accelerometers triad** and the 3 axes of the **gyroscopes triad** define a single, shared, orthogonal 3D frame called an “Inertial Measurement Unit” (IMU) and forms the heart of any inertial reference system. When an IMU is coupled to a calculator and an interface, the result is an “inertial reference system”.

15. BizGyro Configuration Commands:

The motion sensor responds to multiple predefined control commands, those commands are divided into 3 categories, “configuration” commands, “read” commands and factory reserved commands.

We will list the first two categories, the user can use those commands when configuring the Motion sensor using external tools or when interfacing with an embedded systems.

1. Configuration Command category

The configuration category is used basically to configure the motion sensor according to the customer needs. All the commands starts with the ASCII character '$' and ends with the ASCII character '#' followed by the parameter value, all commands are terminated with <CR><LF> the Carriage Return and Line Feed.

command	description	example
$setfrq#	Configure the sensor output frequency	$setfrq#100<CR><LF>
$setbd1#	Configure the sensor baud-rate, for the main RS232 serial port.	$setbd1#115200<CR><LF>
$setbd2#	Configure the sensor baud-rate, for the RS422 serial port.	$setbd2#115200<CR><LF>
$setbd3#	Configure the sensor baud-rate, for the secondary RS232 serial port (GPS232).	$setbd3#115200<CR><LF>
$sethd1#	Configure the output protocol header part 1.	$sethd1#$hdr<CR><LF>
$sethd2#	Configure the output protocol header part 2 (if applicable).	$sethd2#<CR><LF>
$setprt#	Configure the output protocol format.	$setprt#255.248.0.0<CR><LF>
$setsrp#	Configure the UDP/TCP source port number.	$setsrp#6350<CR><LF>
$setdsp#	Configure the UDP/TCP destination port number.	$setdsp#6335<CR><LF>
$setsip#	Configure the Motion Sensor UDP/TCP IP number(static IP only).	$setsip#192.168.1.100<CR><LF>
$setdip#	Configure the UDP/TCP destination (Target) IP number.	$setdip#192.168.1.255<CR><LF>
$setflg#	Configure the sensors' flags, such as data invert flags, and some other flags, this includes some reserved flags.	$setflg#255.0.0.0<CR><LF>
$setrof#	Configure the offset value for Roll angle.	$setrof#0.0<CR><LF>
$setpof#	Configure the offset value for Pitch angle.	$setpof#0.0<CR><LF>
$setyof#	Configure the offset value for Yaw angle.	$setyof#0.0<CR><LF>

2. Read Command category

The read category is used basically to read and verify the configuration status of the motion sensor. All the read commands start with the ASCII character '$' and end with the ASCII character '#', some commands are followed by a certain parameter index, all commands are terminated with <CR><LF> the Carriage Return and Line Feed.

commands	description	example
$getfrq#	read the sensor output frequency value	$getfrq#<CR><LF>
$getbd1#	read the sensor baud-rate value, for the main RS232 serial port.	$getbd1#<CR><LF>
$getbd2#	read the sensor baud-rate value, for the main RS422 serial port.	$getbd2#<CR><LF>
$getbd3#	read the sensor baud-rate value, for the secondary RS232 serial port.	$getbd3#<CR><LF>
$getprt#	read the output protocol format	$getprt#<CR><LF>
$getsrn#	read the Motion sensor serial number	$getsrn#<CR><LF>
$getsrp#	read the UDP/TCP source port number	$getsrp#<CR><LF>
$getdsp#	read the UDP/TCP destination port number	$getdsp#<CR><LF>
$getsip#	read the Motion Sensor UDP/TCP IP number	$getsip#<CR><LF>
$getdip#	Set the UDP/TCP destination (Target) IP number	$getdip#<CR><LF>
$getflg#	read the sensors' flags, such as data invert flags, and some other flags, this includes some reserved flags	$getflg#<CR><LF>
$getrof#	read the offset value for Roll angle	$getrof#<CR><LF>
$getpof#	read the offset value for Pitch angle	$getpof#<CR><LF>
$getyof#	read the offset value for Yaw angle	$getyof#<CR><LF>

3. Output Protocol Command Format

The output protocol format is configured using a register of 32 bits. The output protocol set command uses ASCII representation to transfer the register value to the sensor, the set command uses 4 groups of 8 bits character separated with the dot character (.), each bit in each group represents one parameter, if the bit is set high then the corresponding parameter is enabled otherwise the parameter is disabled.
the parameters and the corresponding bit order is listed in the table bellow.

group	Bit order	parameter
1	7	Roll
	6	Pitch
	5	Yaw
	4	Roll Rate
	3	Pitch Rate
	2	Yaw Rate
	1	Heave
	0	Heave Velocity
2	7	Ax
	6	Ay
	5	Az
	4	Watch dog counter
	3	checksum
	2	NA
	1	NA
	0	NA
3	7-0	NA
4	7-0	NA

Example:
lets assume that the desired output parameters are:
Roll, Pitch, Yaw, Heave, Ax, Ay, Az, counter and check sum.
The parameters belong to group 1 (Roll, Pitch, Yaw and Heave), and group 2 (Ax, Ay, Az, counter and check sum).
The first group byte is going to be: 1110 0010 = 226
the second group byte is going to be: 1111 1000 = 248
for the none applicable groups, simply a value of 0 has to be used.
the set command in this particular case will have the following form:

$setprt#226.248.0.0<CR><LF>

3.1 Standard output Protocol command format

For the standard predefined protocols the following predefined values are used.

protocol	Command
TSS1	$setprt#0.0.0.1<CR><LF>
TSS3	$setprt#0.0.0.3<CR><LF>

4. Motion Sensor Flag command format

The flag command is used to ensure maximum flexibility of the sensor output.
The flags are used by the sensor to mathematically invert the values of the following parameters:
Roll, Pitch, Yaw, and Heave.
A specific flag bit is used to switch between dynamic IP and static IP when Ethernet output is active.
Some other flags are reserved for future use.
In total 32 bits (flags) is used by the flag control command, in similar way to the protocol command format, the flags are separated in 4 groups of ASCII characters.
When the flag is set to High (1) the action is executed.
The flags is listed in the table bellow:

group	Bit (flag) order	Flag control parameters
4	7-0	NA
3	7-0	NA
2	7-0	NA
	5-7	NA
	4	Dynamic IP Flag
	3	Heave sign inversion Flag
	2	Yaw Angle inversion Flag
	1	Pitch Angle inversion Flag
	0	Roll Angle inversion Flag

Example: if the **Roll Flag** and **Heave Flag** are set to high, then the flag control command has to be:

$setflg#0.0.0.9<CR><LF>

5. Motion Sensor Factory Information

If you experience any difficulties configuring the Motion Sensor, or if you have any inquiry regarding the motion sensor, please contact your local agents or Bizclap S.r.l directly, Refer to website: www.bizclap.it

Please have the following information available:

- ➢ Equipment Serial Number.
- ➢ Brief description of the issue.

The serial number can be found on the warranty certificate accompanied the Motion Sensor at deliver time, alternatively, you can get the serial number from the Motion Sensor it self.
to get the serial number, if you wish to use the control panel, just click on the info icon in the control panel toolbar, a popup message will appear showing the serial number of your unit.

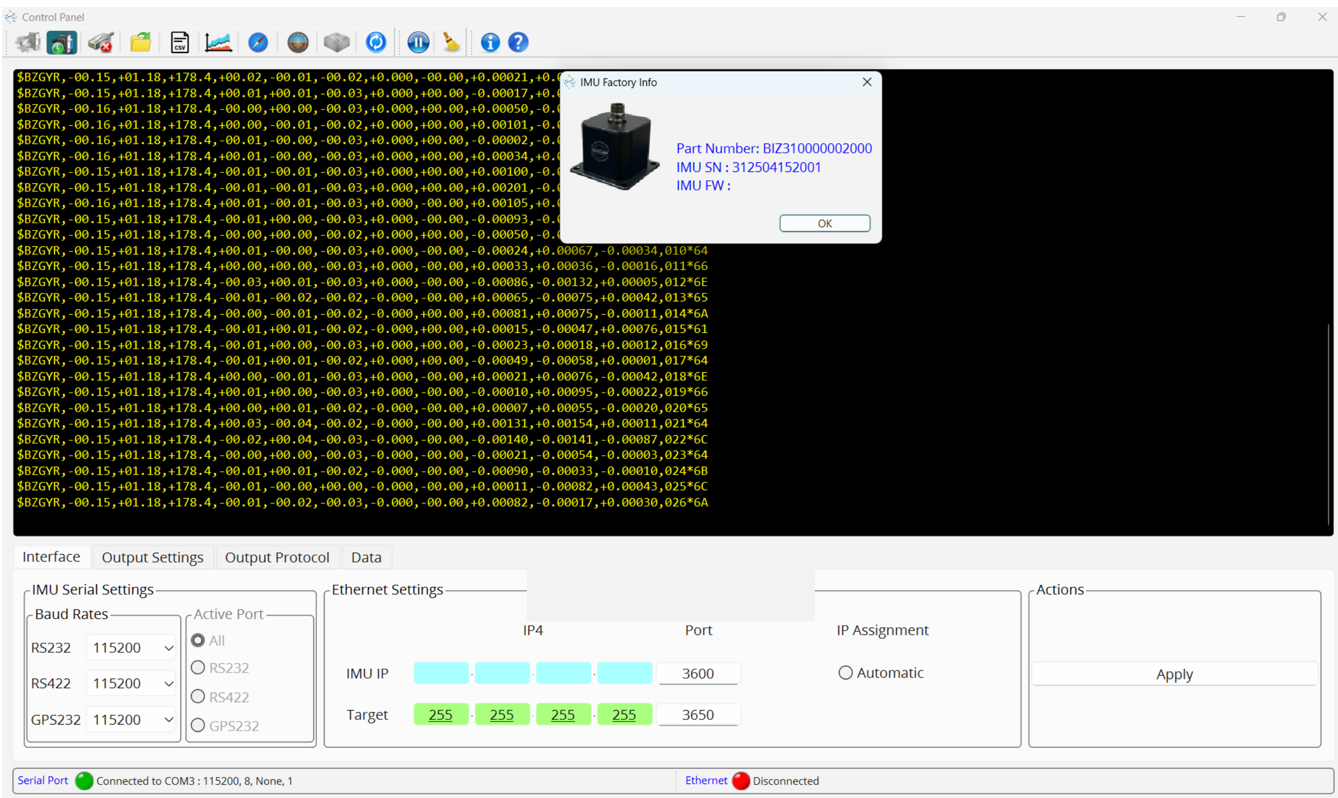


Figure 22: IMU Serial Number

If you are using RealTerm, you can use the control command to get the serial number: Bizclap S.r.l recommends that the User Keep the warranty certificate for any potential future need.

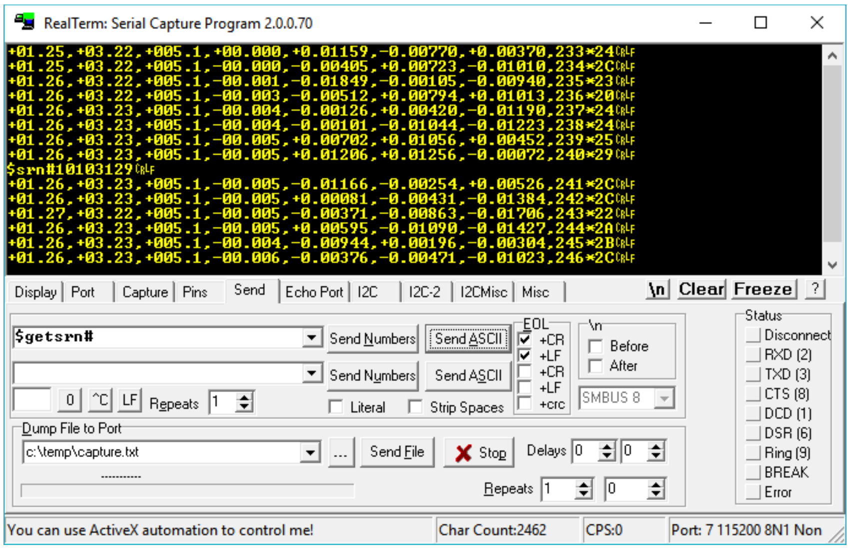
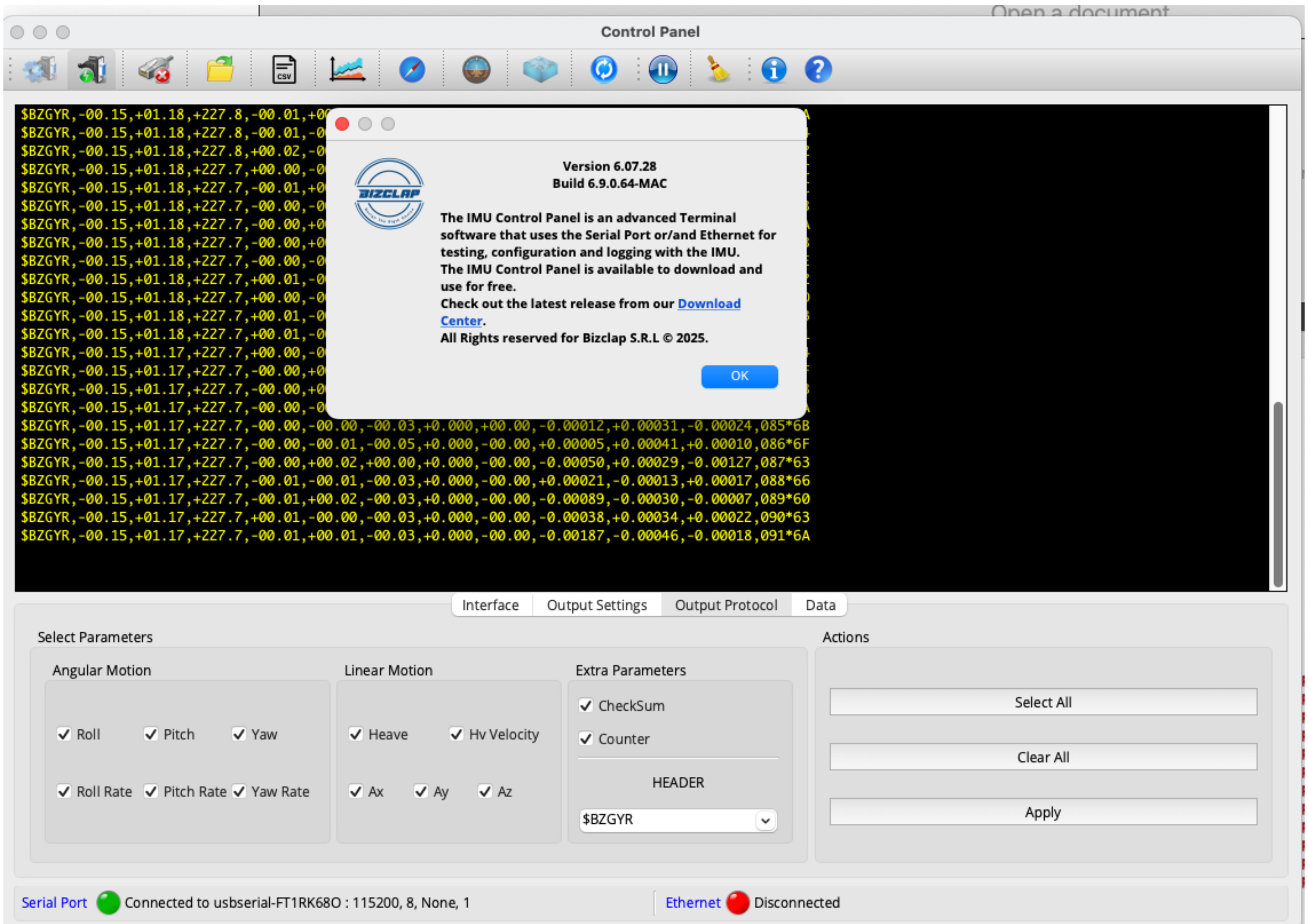


Figure 23: Serial Number Control command

16. Control Panel Software

The control panel software is available for both Windows and Mac OS.
In the following sections we are going to explain the installation of the control panel software and how to configure the motion sensor under all supported operating systems.

The opening screens of this chapter show the **BizGyro firmware version** and the **Control Panel version**; the same information is always visible from the Dashboard (information **"i"** icon).



Installation Guide For Windows

You can download the control panel from Bizclap S.r.l website:
https://www.bizclap.it/bizclap-gyrocompass-bizgyro

The control panel is free software and does not require any license.
Here is the steps to install the control panel on Windows 7 or higher:

- ➢ terms and conditions agreement:

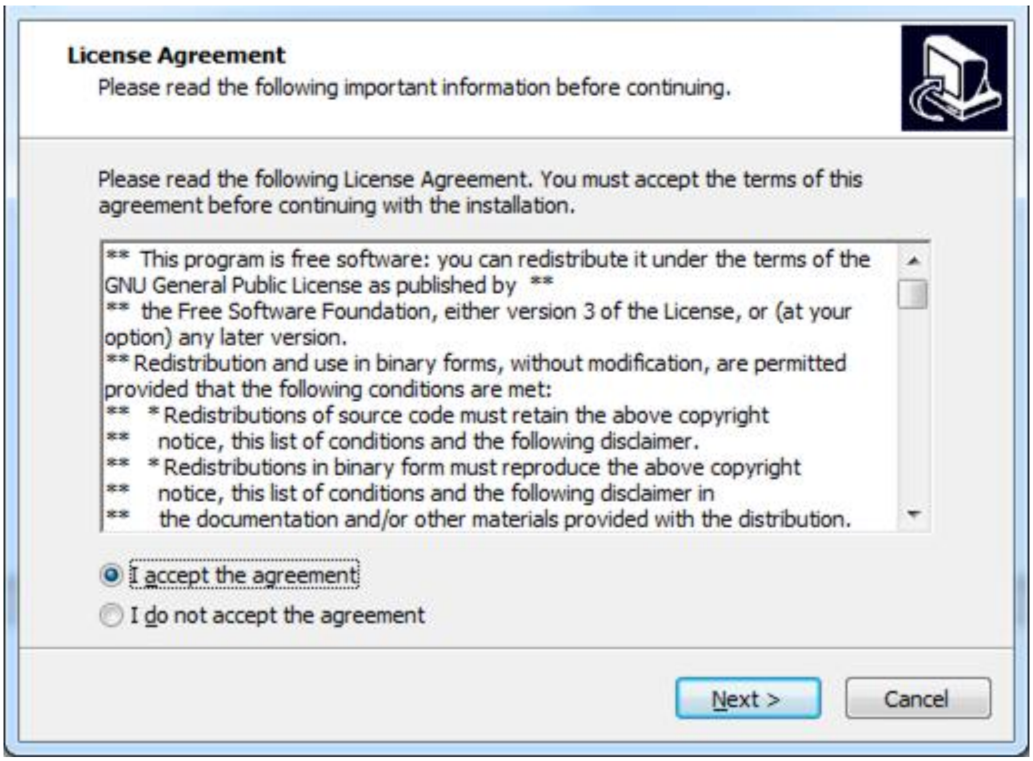


Figure 24: Terms & Conditions

- ➢ Select the installation folder.

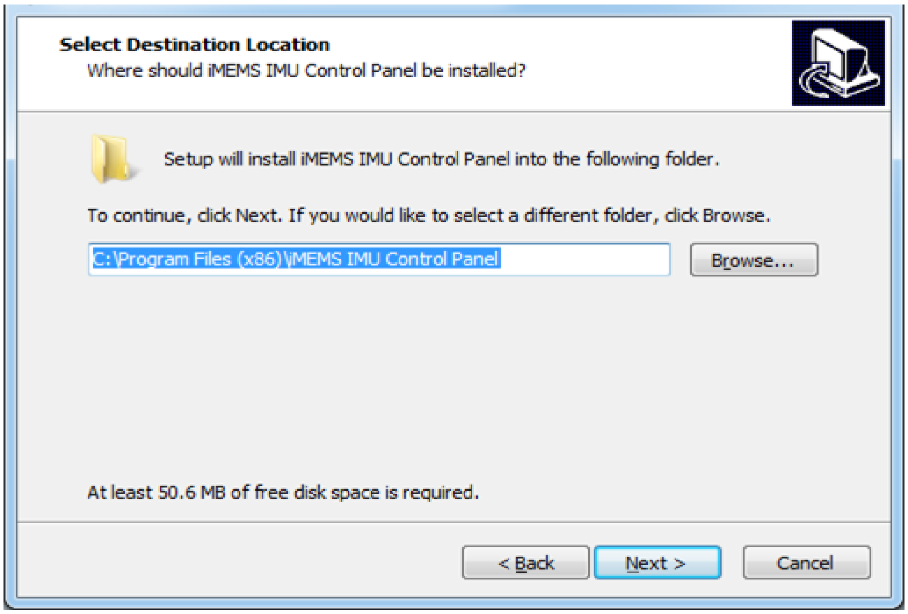


Figure 25: installation folder

- ➢ Complete the installation

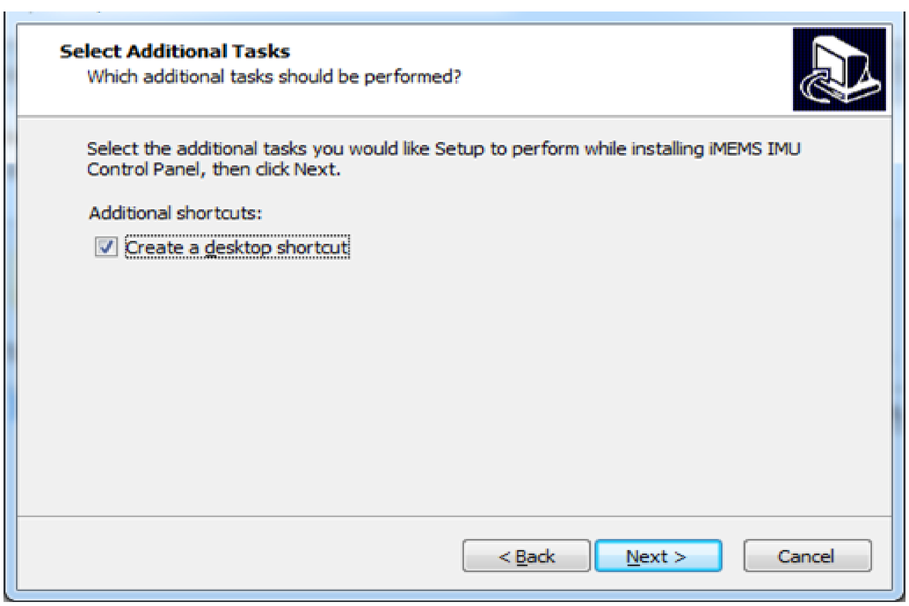


Figure 26: Complete installation

17. Control Panel

Here is how the control panel looks like after finishing the installation.

Tabs and Main View options

The main window in the control panel view allows a very quick access to the rest of the other tabs of the control panel.

Main view

1. Serial port select:

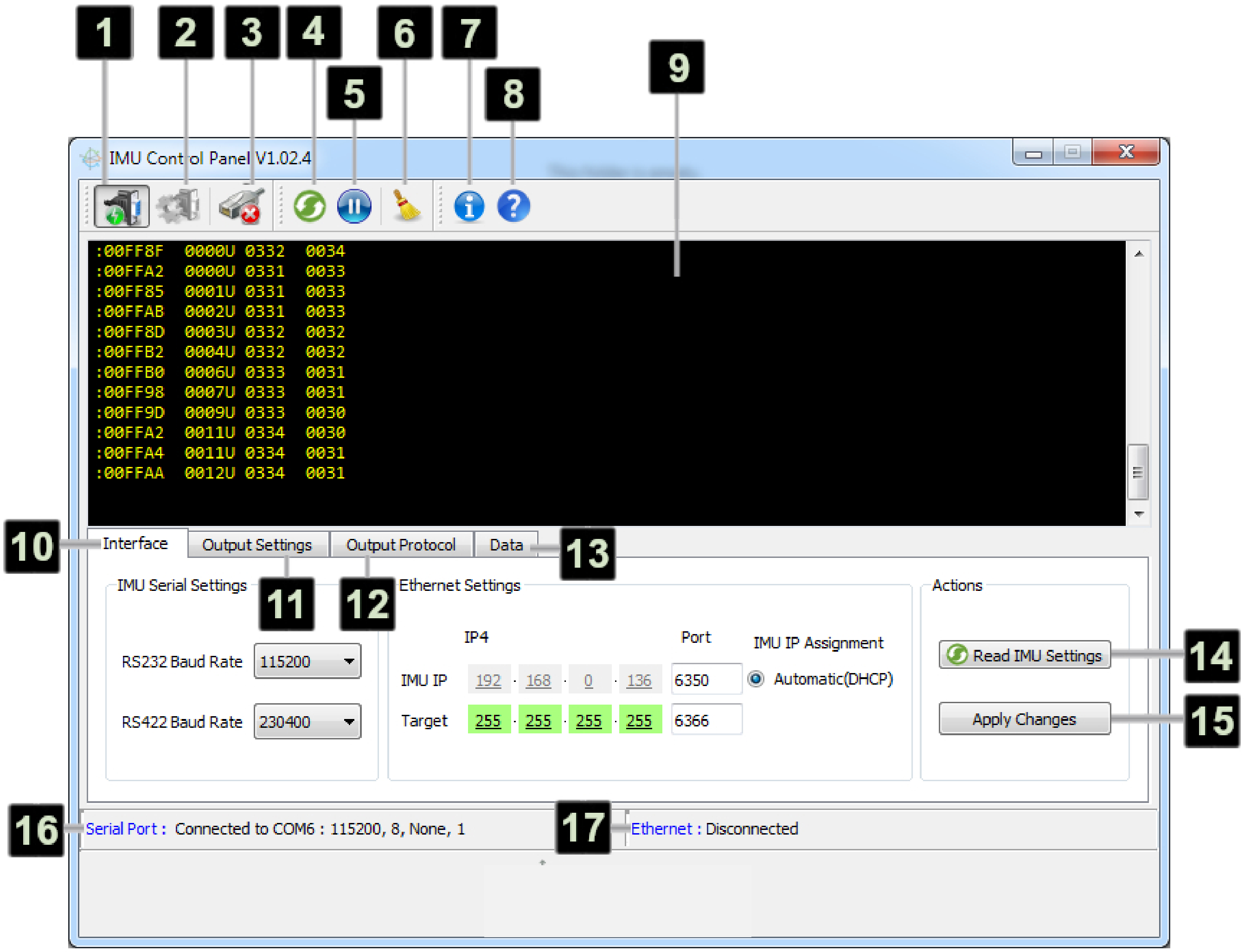


Figure 27: Main View

if the IMU is connected via serial port and the user setup a correct baud rate, correct port, the data is going to be displayed in the terminal window.

2. Serial port configuration and scanning:

when clicking on this tool button a popup window will allow access to set the baud rate and the com port number.
if you are not sure to which serial port the IMU is connected you can auto detect it using the Serial port scanning option.

3. The Ethernet:

if you click on this tool button the control panel is going to scan the local network for any Aurora sensor, when Aurora is detected the data is going to be displayed in the terminal window.

4. Read IMU settings:

when ever you decide to read the IMU settings status you can click on this tool button.

5. Halt the terminal window:

when you click on this tool button there will not be any new data displayed in the terminal window.

6. Clear the Display:

clean the terminal window.

7. Information button:

It will show the serial number of the IMU.

8. About the Control panel:

information about the control panel you are using.

9. Terminal Window

It displays the current data captured via serial port or Ethernet based on user selection. It also displays the control commands and commands answers.

10. Interface:

This tab let you configure or read the main IMU settings.

11. Output settings:

Another tab to set or get some Output parameters.

12. Output Protocol:

Multiple check boxes where the user can configure his customized protocol.

13. Data tabs:

More visual information to monitor the motion sensor output. It also provides a chart view where you can monitor the waveform of the output signals.

14. Serial Port status bar:
A read only information displaying the connection status with the serial port.

15. Ethernet status bar:
A read only information displaying the connection status with the Ethernet.

Interface Tab

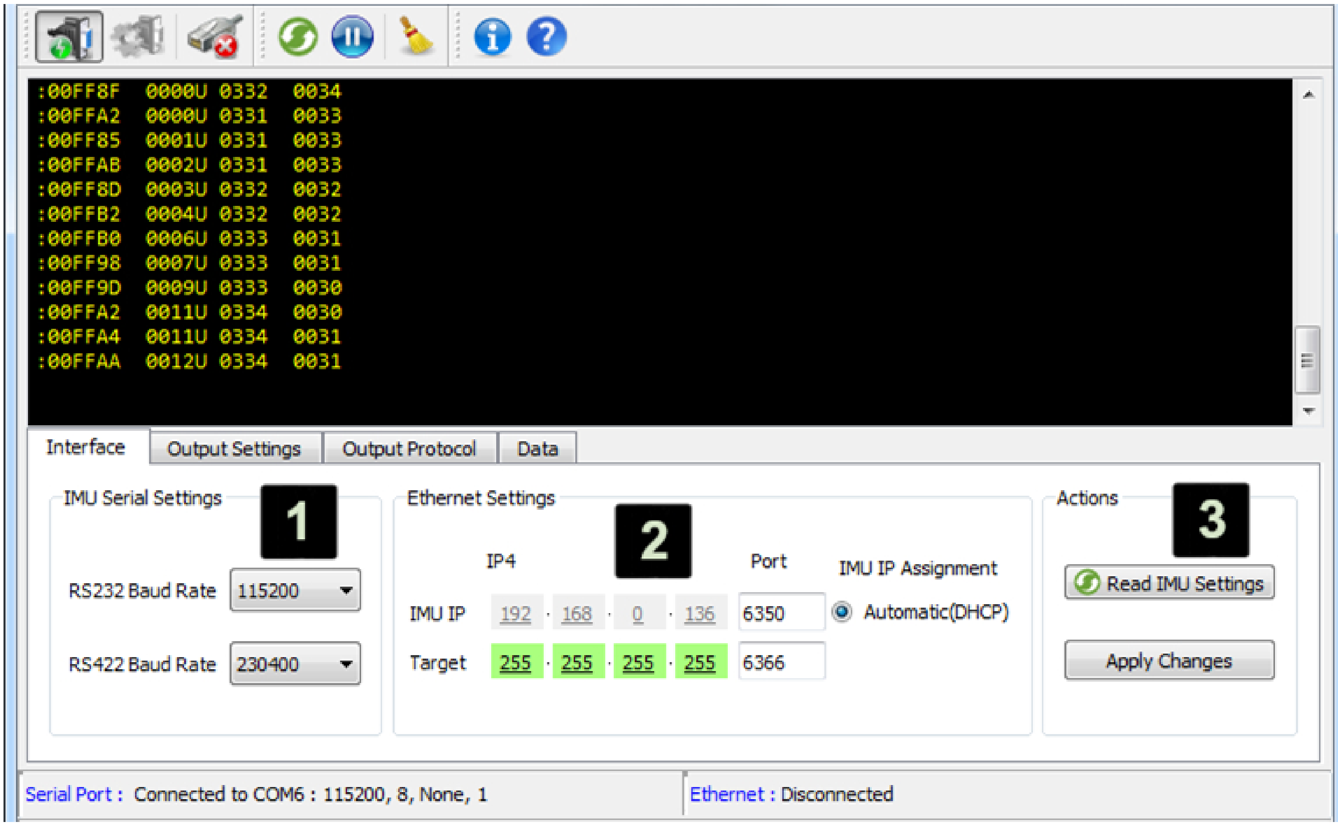


Figure 28: Interface tab

1. IMU Serial Settings combo box:

A list to configure or read the Baud rate for both RS232 or RS422.

2. IMU Ethernet Settings:

Multiple options to configure or read the IMU IP address, target IP address, IMU Port number and target port number.
Another option to configure or read the IMU IP type (static/dynamic).

3. Actions:

After setting up any parameter from the interface tab you have to click on the apply button in order to execute the changes. If you wish to read the IMU current configuration you can click on the Read IMU settings button.

Output Settings Tab

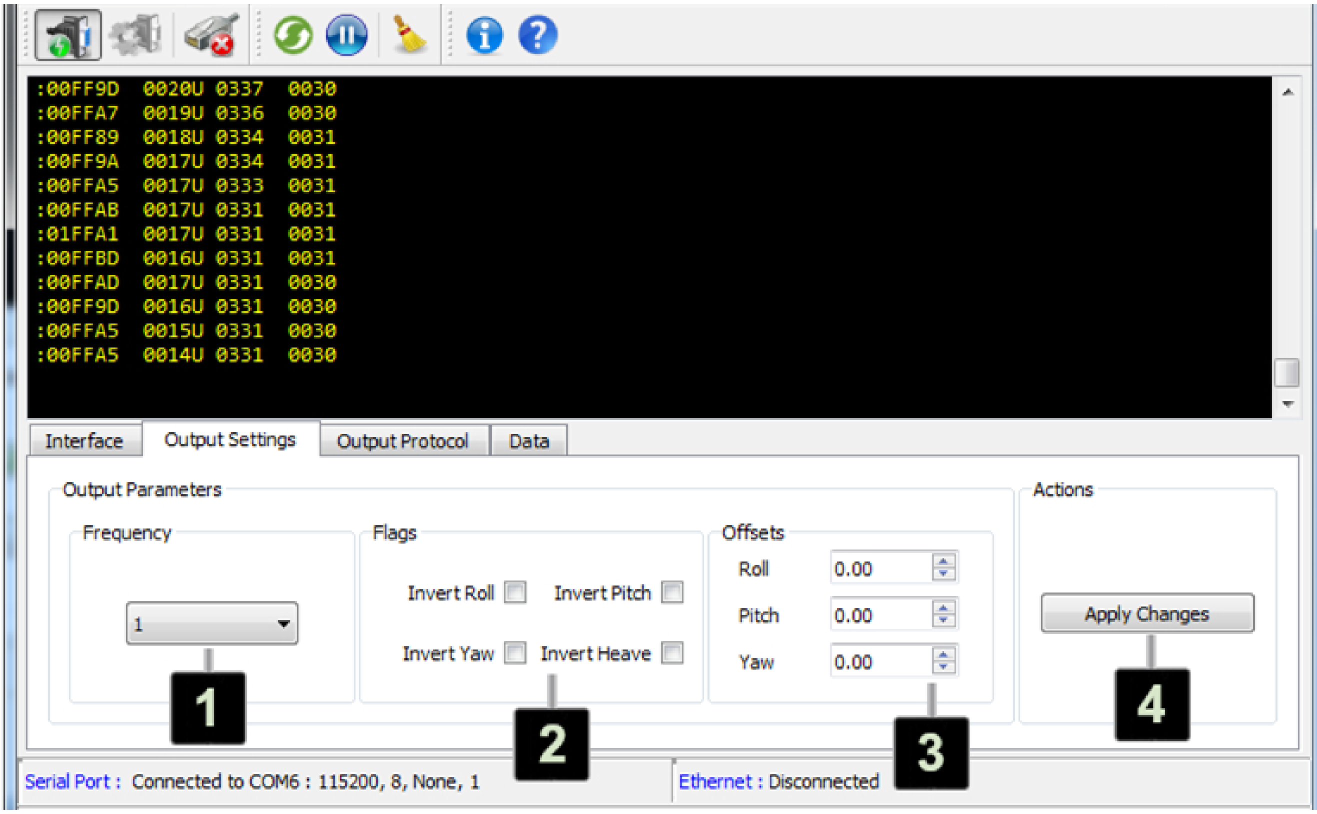


Figure 29: Output Settings

1. Frequency Combo Box:

A list to configure or read the IMU output frequency.

2. Flags:

Multiple check boxes to configure or read the phase of Roll, Pitch, Yaw or Heave.

3. Offsets:

Configure or read the Roll, Pitch, Yaw offsets

Output Protocol Tab

The user customized output protocol tab. For more details refer to the section (Output Data Format).

Output Data Tab

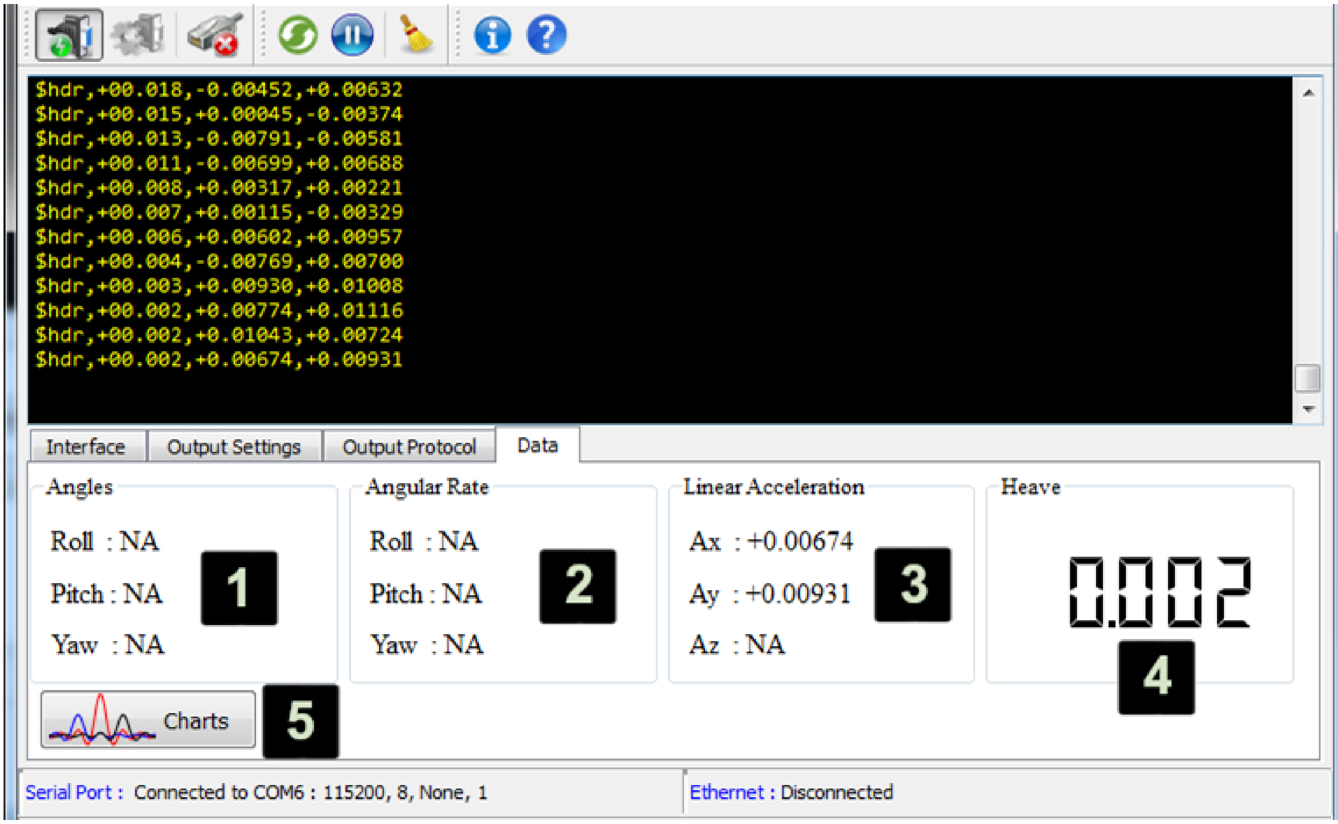


Figure 30: Data

1. Momentary Angles Values
2. Momentary Angular rate Values
3. Momentary Linear Acceleration
4. Heave Momentary value
5. Charts View

The chart View offers a flexible floating window for real time data monitoring.
For more information see the chart view section.

Installation Guide For Mac OS

The control panel is available as an application package for Mac OS 10.11 and higher, after downloading the compressed package, you just need to extract it by double clicking the zip package.

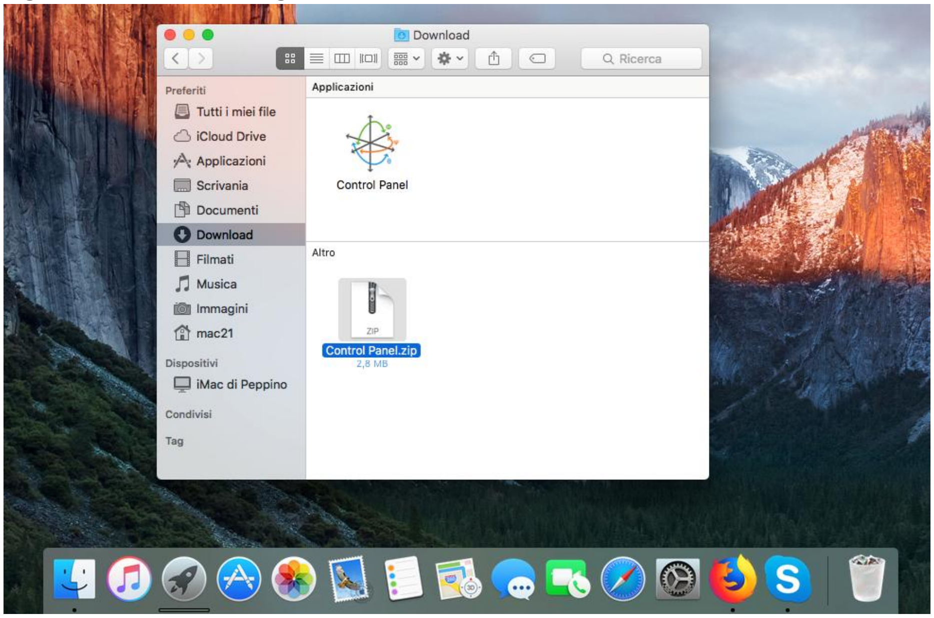


Figure 31: Control Panel Zipped

Simply drag and drop the application package in your application folder. Navigate to your application folder or application launcher, where the Control Panel application icon should be located.
you just click or double-click the application's icon to run the application.

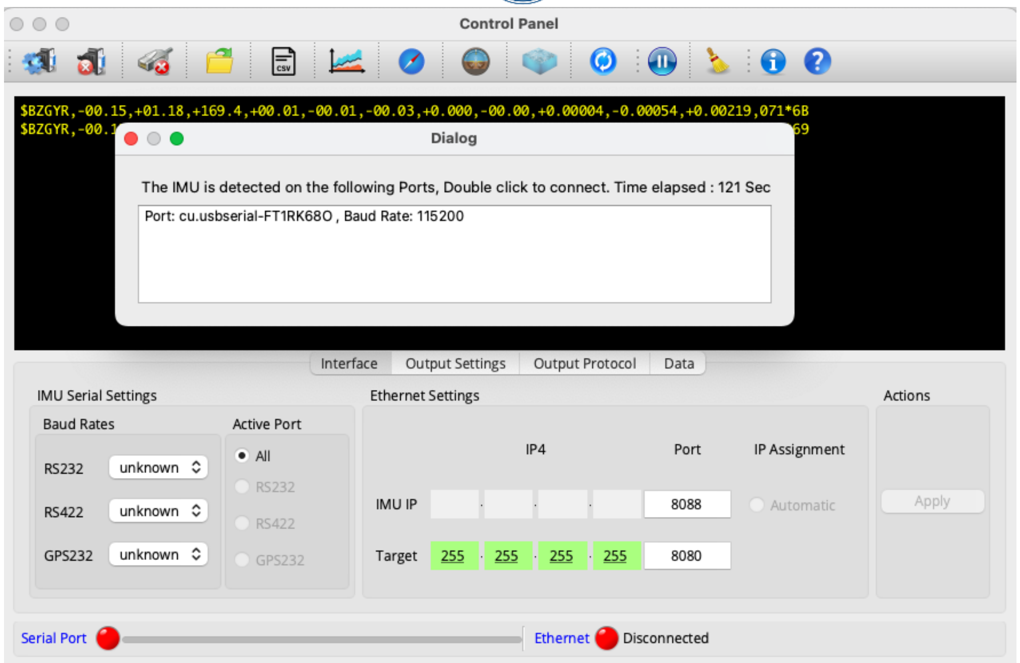


Figure 33: Control Panel detects Serial Port connected to the IMU

Connect to the sensor, you can use the auto detect option.
As soon as the connection is done with the Motion sensor the control panel starts reading all the user settings:

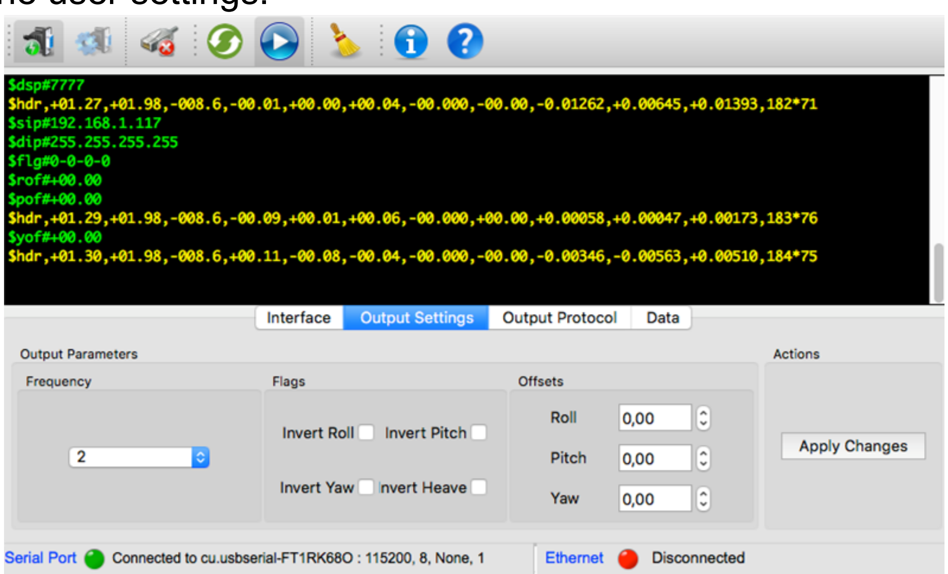


Figure 34: Reads of the User settings

now you can customize the Sensor settings as desired.

18. Control Panel Chart View

Bizclap Control panel supports a floating window chart view for real time data monitoring.

The chart view is available in both operating system Windows and Mac OS.

Main View

To have access on the chart view, click on the charts button or icon in the Data Tab.

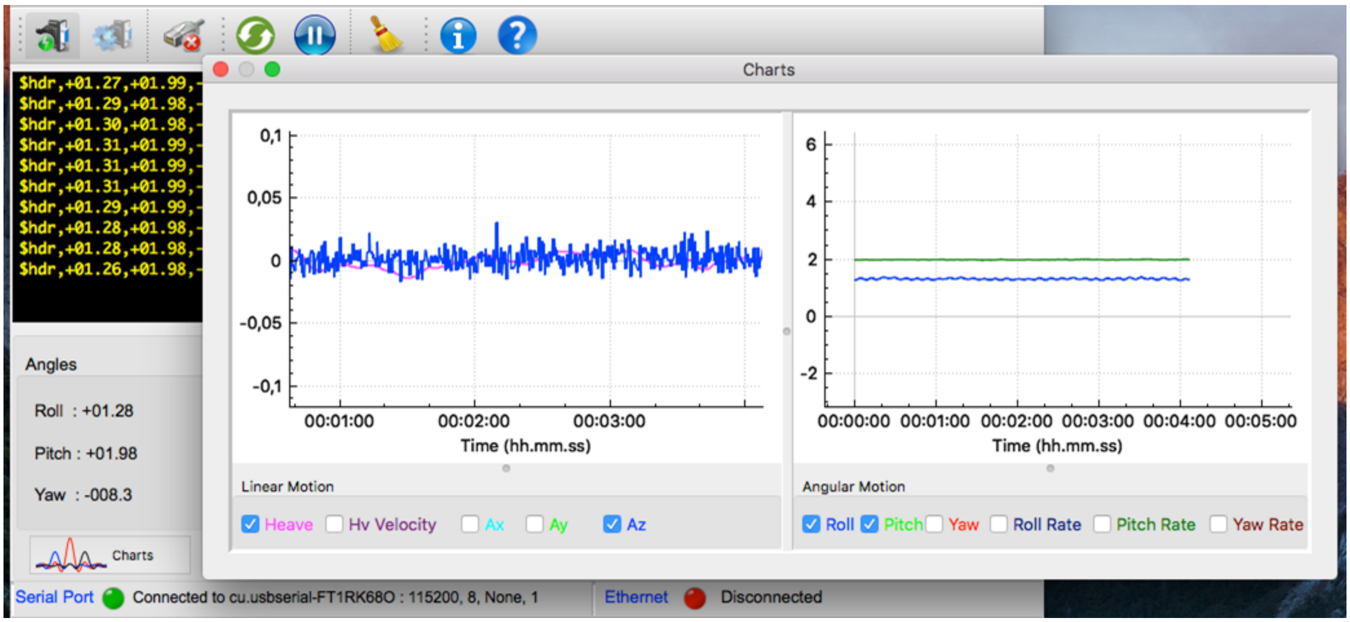


Figure 35: Charts View

Charts Options

The charts view is divided into two categories. On the left side is the linear motion parameters window, on the right side is the angular parameters window.

In each window you can monitor one or multiple parameters, just tick the check box next to the parameter name.

Example:

In the following example, we are monitoring the linear heave, linear vertical acceleration(Az), Roll angle and Pitch angle.

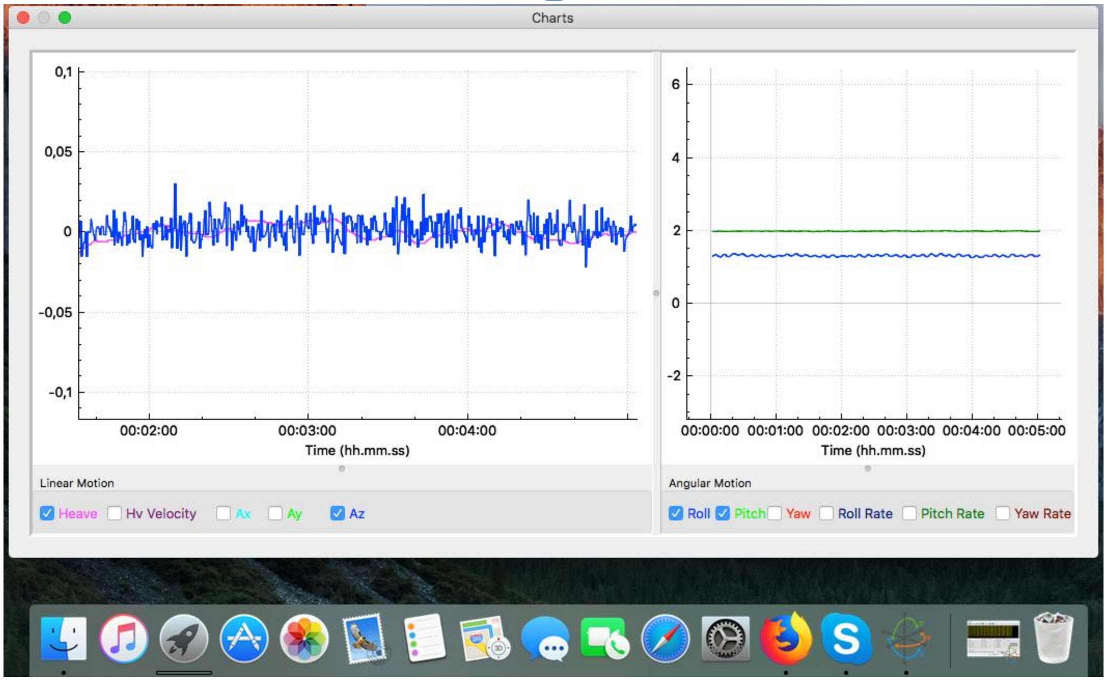


Figure 36: Charts View Monitoring Example

The charts view supports expanding or overlapping each other.

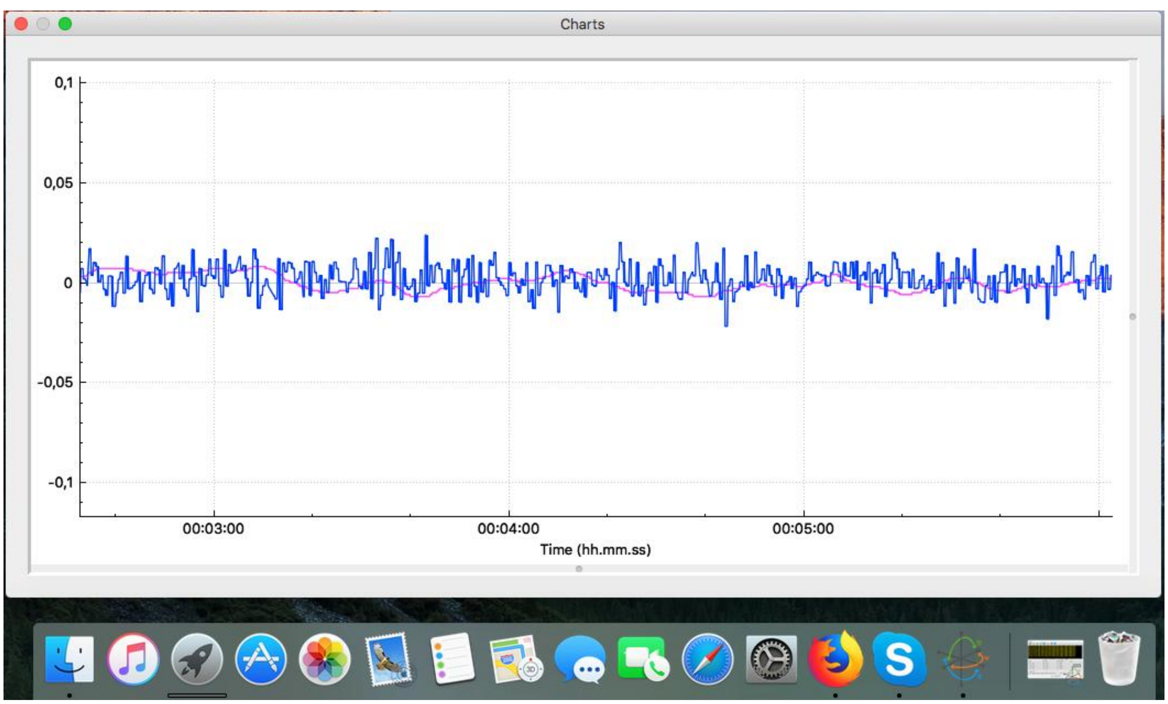


Figure 37: Example of fully overlapped view

19. External tools to Configure Aurora

Aurora family is very flexible. To configure the Motion sensor, you can utilize the control panel provided by Bizclap S.r.l or you can use any terminal software supporting communication with UART. If you are using windows machine you can use for example:

→ RealTerm

→ TeraTerm

for Mac machine you can use:

→ Serial Utility

→ Serial Tools

in the following section we are going to explain how you can use the RealTerm under windows and serial Tools under MAC to setup and control the Aurora family.

For RealTerm do the following steps:

→ download and install RealTerm. You can get it from https://realterm.sourceforge.io/

→ After the installation go to start → all programs → RealTerm folder → RealTerm

→ in RealTerm program go to port tap

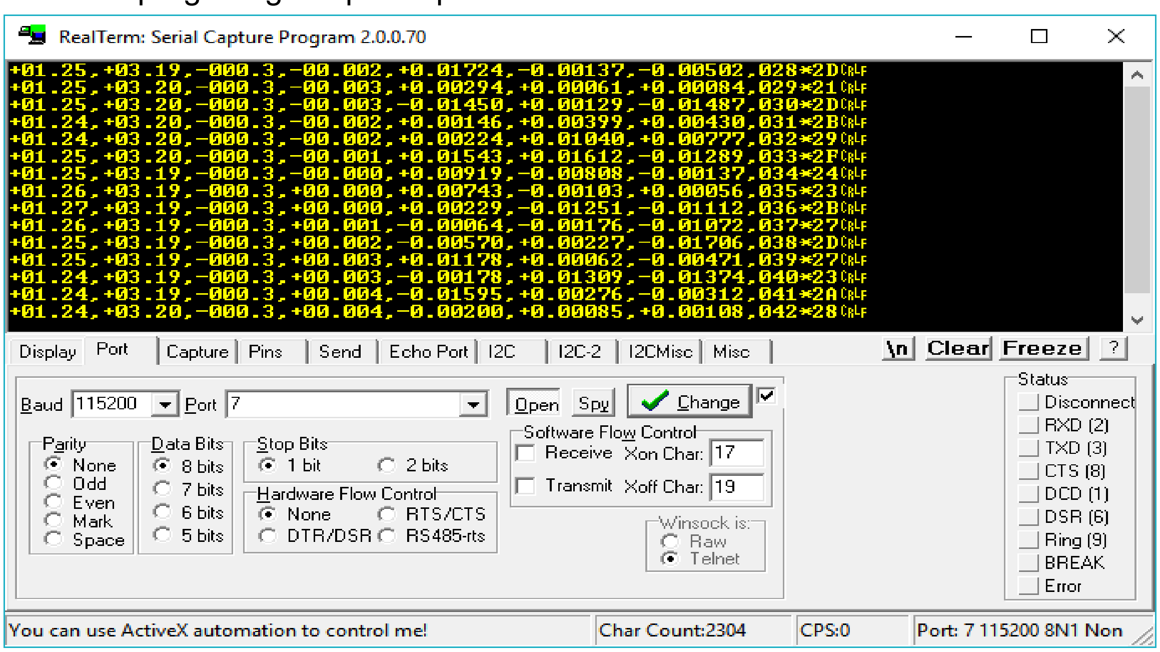


Figure 38: Configuring the Sensor with RealTerm

→ select the baud rate and the port number then click Open or Change.

For sending control command to the Motion Sensor, in RealTerm, go to *Send* Tab, type the command in the edit text box, make sure to tick both the **CR** and **LF** check box, then click the **Send ASCII** button, the sensor will echo back a message to confirm that the control command has been successfully executed.

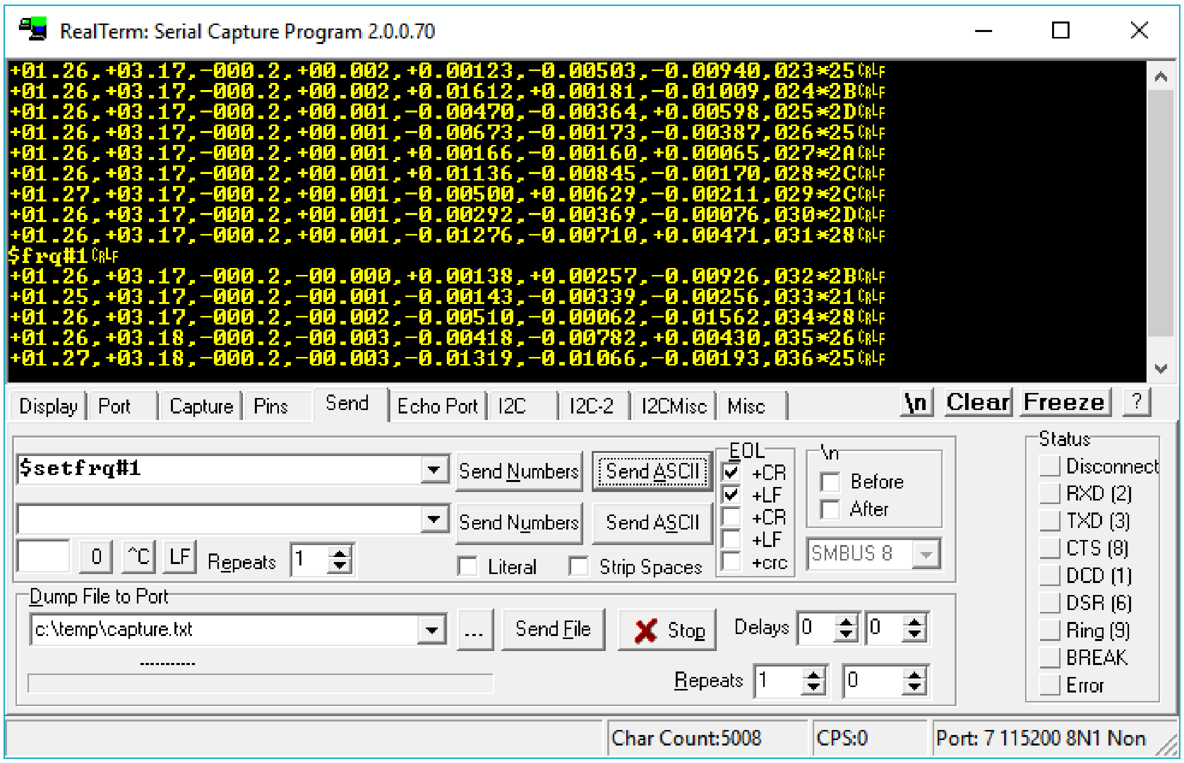


Figure 39: Control Command with RealTerm

For MAC OS, you can download the Serial Tools from the app store:

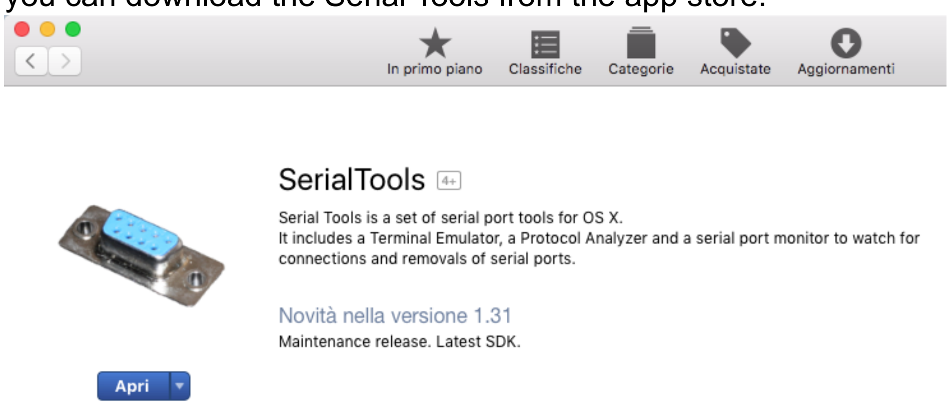


Figure 40: Serial Tool For MAC OS

After launching Serial Tools, you can select a *New Session* or open an existing session file. You can also launch Serial Tools by double clicking on a previously saved Session file.

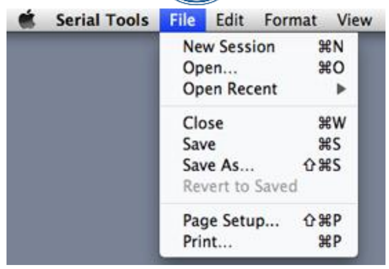


Figure 41: Serial Tool New Session

When you select *New Session*, a new untitled Serial Tools session window will appear.

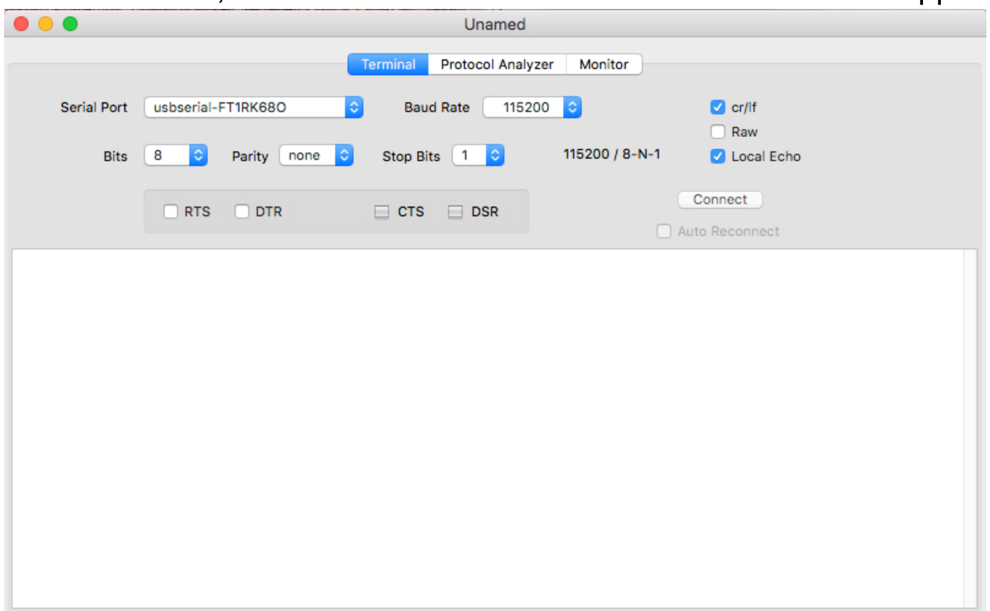


Figure 42: Serial Tools configuration

You can choose the baud rate, the number of data bits, data parity and the number of stop bits. Your selection also shows up as a common designation, as in "115200 / 8-N-1" above.
Click on the **Connect** button to open a connection to the serial port.
select the **cr/lf** checkbox, so for each newline an ASCII carriage return character and a linefeed character will to be sent.

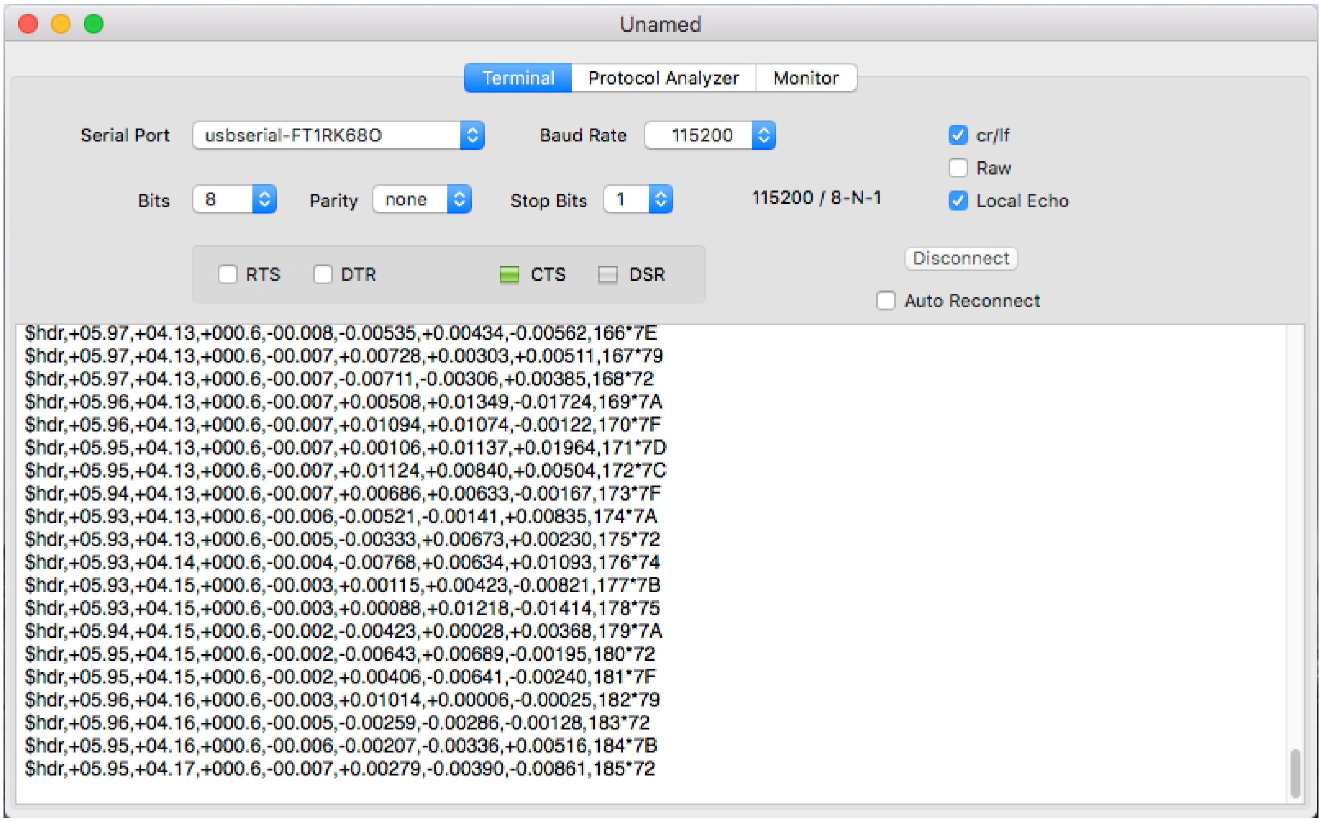
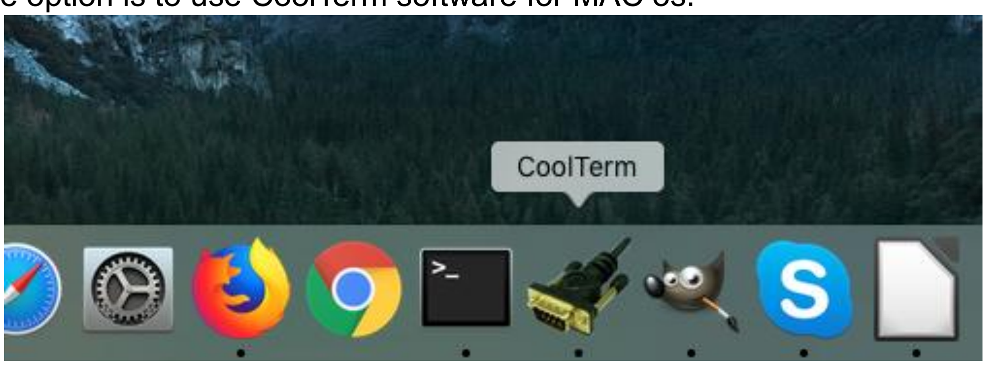


Figure 43: SerialTool Connect

An alternative option is to use CoolTerm software for MAC os.



After starting CoolTerm, You can configure the CoolTerm to send control command to the motion sensor.
To do this make sure to tick the check box in the Options → Terminal→ Line Mode.

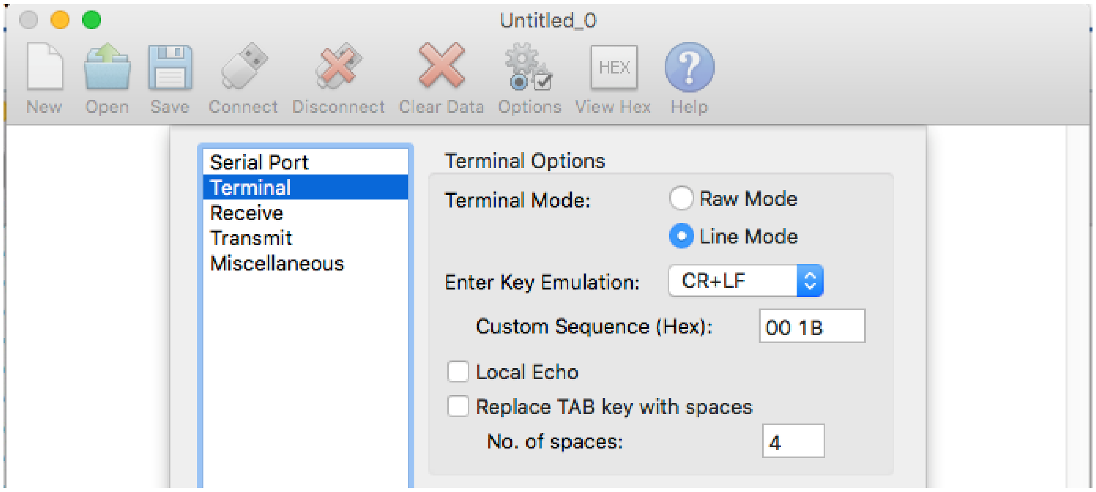


Figure 44: Configuration of CoolTerm

When the configuration is done correctly, click on Connect, Type in the control command in the command line, the Motion sensor will echo back the answer verifying that the command was correctly executed.

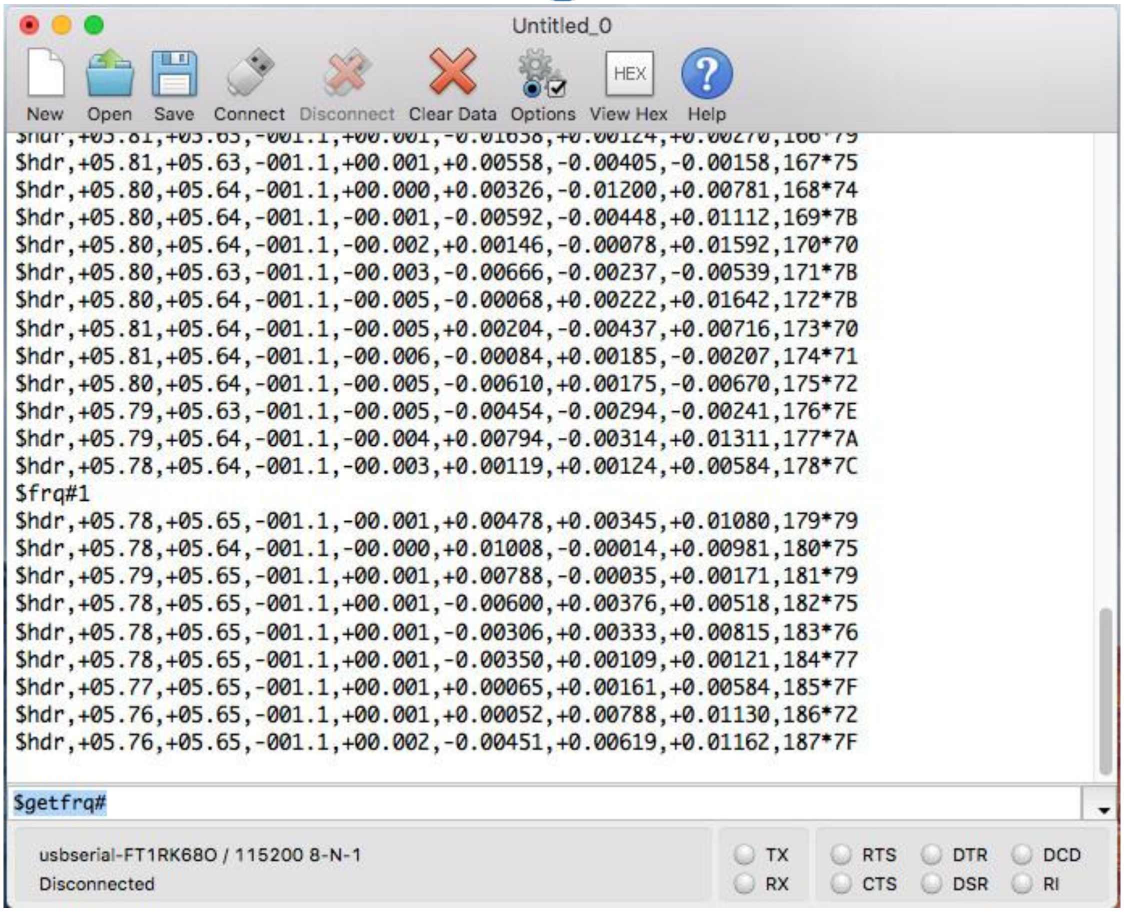


Figure 45: sending control command to the IMU

20. Services & Warranty

If you experience any difficulties configuring the sensor, or if any other kind of problems, or you have any inquiry regarding the motion sensor please contact your local agents or Bizclap S.r.l directly.

Refer to website: www.bizclap.it
Please have the following information available

- Equipment Serial Number

- Description of issue or problem

Worldwide Service contact
info@bizclap.eu
phone number: **+39 011 1911 5482**

1. WARRANTY

Bizclap S.r.l offers **warranty** against defects arises within 24 months of purchase.
Our liabilities are limited to repairing, replacement, or refund of the factory quoted price.
Bizclap S.r.l must be notified and provided with sufficient information and time to remedy any product deficiencies that require factory attention. This time period may include but is not limited to standard production lead times and raw material lead times.
Bizclap S.r.l strictly recommend that its manufactured product must be sent only to Bizclap S.r.l facilities for repair or replacement.

2. Return of products

In case of the return of products Customer shall be obliged to return all of the products and the rights granted to him under the terms of this agreement at his own risk. All products shall be returned in their original packaging. Before returning the product Bizclap S.r.l the Customer shall delete all data stored on the product (if applicable).
Please refer to Bizclap S.r.l terms and conditions for more information.

21. Troubleshooting

If bad or corrupted data is displayed, or if no output data at all is seen please refer to the following FAQs which cover the most common issues related to the latest configuration.

- **How can I check Firmware Version?**

The installed firmware version is visible from the Dashboard (information **"i"** icon).

- **How can I update the BizGyro Firmware?**

Firmware updates are managed by Bizclap; contact support to obtain the package and instructions.

- **Who will be authorized to update the firmware?**

To ensure traceability and consistency with the type certificate, updates are performed by Bizclap personnel or authorized centers.

- **Where the firmware version update will be recorded?**

After the update, record the new version in the vessel log/maintenance record.

- **Are you running the latest control panel and/or firmware?**

If not, please update your control panel and/or firmware.

- **Have you set the correct sample rates (Baud Rate) with your computer/PLC … and the Motion Sensor?**

If you are not sure about the Baud rate, please refer to the Auto detect option in the control panel software, please note that The default baud rate set when the unit is shipped is **115200**.

- **Which serial port is active, RS422 or RS232?**

When the motion sensor is powered on and running, it sends out data and receives commands over all the serial ports channels.

- **Is the sensor powered up and fully operational?**

Voltage should be no less than 6.5 and no more than 36 VDC, the recommended power voltage is 12 VDC, the sensor draws approximately no more than 300 milliampere [mA] of current from a 12V supply when fully active and running.

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