VERONTE
AUTOPILOTS

Hardware User Manual
Veronte 4

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Figures and Tables

Acronyms

ADC	Analog to Digital Converter
AWG	American Wire Gauge
CAP	Capture Module
DC	Direct Current
DGPS	Differential GPS
DTS	Digital Transmission System
ECAP	Enhanced CAP
EGNOS	European Geostationary Navigation Overlay Service
EPWM	Enhanced PWM
FCS	Flight Control System
FHSS	Frequency Hopping Spread Spectrum
FTS	Flight Termination System
GIS	Geographical Information System
GND	Ground
GNSS	Global Navigation Satellite Systems
GPS	Global Positioning System
GS	Ground Segment
ISM	Industrial Scientific and Medical
LADGPS	Local Area
LOS	Line of Sight
PWM	Pulse Width Modulation
PWR	Power
RF	Radio Frequency
RS232	Recommended Standard 232
RX	Receiver
SMA	SubMiniature Version A Connector
TX	Transmitter
UAS	Unmanned Aerial System
UAV	Unmanned Aerial Vehicle

CHANGES RECORD

Issue	Date	Change description
1.0	10/04/2017	Initial Issue document
1.1	15/05/2017	Safety information added
1.2	19/05/2017	Digital inputs voltage range changed.
1.3	20/09/2017	Mechanical drawing updated.
1.4	25/09/2017	Table 1 updated
1.5	20/12/2017	Section 4.4 added.
1.6	21/12/2017	Errata correction on section 4.4
1.7	24/05/2018	Power and torque updated. Colour code added. OEM pinout updated.

1. Overview

Veronte Autopilot is a miniaturized high reliability avionics system for advanced control of unmanned systems. This control system embeds a state-of-the-art suite of sensors and processors together with LOS and BLOS M2M datalink radio, all with reduced size and weight.

1.1 Operation

The unique *Plug ´n Fly* control system, Veronte Autopilot ads fully autonomous control capabilities to any unmanned system for complete operation, compatible with: UAV, Drone, RPAS, USV, UGV…

- **Highly configurable:** Veronte control system is fully configurable; payload, platform layout, control phases, control channels… even the user interface layout can be user defined.
- **Custom routines:**User selectable automatic actions, activated on system event or periodically.
- *Actions:* phase change, activate payload, move servo, go to, onboard log, parachute release…
- *Events:* waypoint arrival, inside/outside polygon, alarm, variable range, button…
- **Telemetry & log:** Embedded datalink for system monitoring and telecommand and customizable user log in both onboard and control station, all with user defined variables and frequency record.
- **External sensor:** Support for external sensor connection: magnetometer, radar, LIDAR, RPM, temperature, fuel level, battery level, weather…
- **Payload & Peripheral:** Transponder, secondary radios, satcom transceivers, camera gimbals, motor drivers, photo cameras, flares, parachute release systems, tracking antennas, pass through RS232 & CAN tunnel...

1.2 Platforms

The Veronte Autopilot is designed to control any unmanned vehicle, either aircraft such as: multirotors, helicopters, airplanes, VTOL, blimps… as well as ground vehicles, surface vehicles or many others. Custom flight phases and control channels provide support for any aircraft layout and performance by using the same software and hardware for: UAS, RPAS, Drone, USV / ASV, UGV…

Figure 1: Veronte FCS Overview

Veronte contains all the electronics and sensors needed in order to properly execute all the functions needed to control the UAV. A Veronte-based FCS contains the following elements:

- Veronte (Air): it executes in real time all the guidance, navigation and control algorithms for the carrying airframe, acting on the control surfaces and propulsion system and processing the signals from different sensors: accelerometers, gyroscopes, magnetometer, static pressure, dynamic pressure, GPS (EGNOS/Galileo compatible).
- Veronte (Ground): apart from linking to other flying Veronte units and supporting manual and arcade modes with conventional joysticks, it can also control a directional antenna in order to expand the maximum range. It communicates to Veronte Pipe (software for ground segment mission management).
- Veronte Pipe: software for mission management at the ground segment. It monitors flying vehicles in real time and can also reproduce past missions in an offline manner. It is also the graphical user interface where commands and flight plans are produced.

2. Safety

Veronte autopilot includes the following features in order to provide your UAS with the best safety performances:

- Redundant IMU.
- Redundant GPS receiver.
- Redundant Pressure sensor.
- Dual core principal microprocessor + dissimilar safety microcontroller (comicro).
- Independent power supply for main system and safety microcontroller.

In case any malfunction occurs in the principal microprocessor, the comicro can activate different safety mechanisms by means of 2 digital outputs and 1 serial port (see table 5).

3. Aircraft Mounting

There are two versions of Veronte autopilot: with or without enclosure.

3.1 Enclosure

Veronte is provided using an anodized-aluminium enclosure with enhanced EMI shielding and IP protection. A high reliability connector is also provided with this version. The total approximate weight is 190g.

Figure 2: Veronte Air

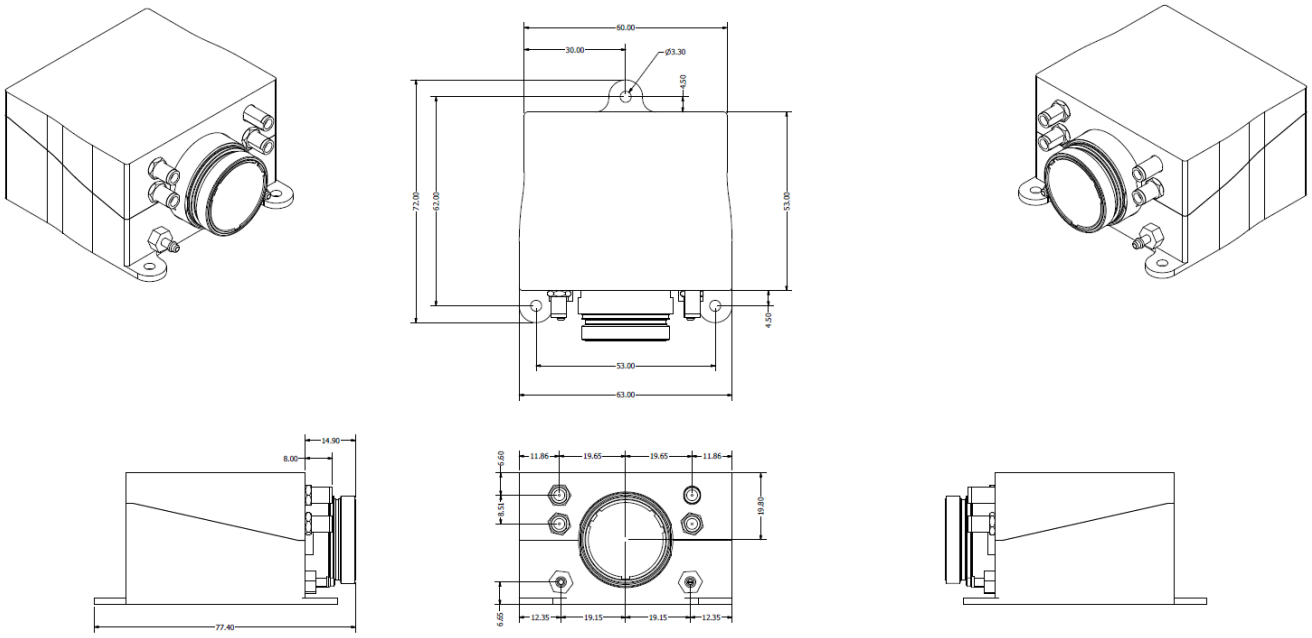


Figure 3: Veronte dimensions (mm)

3.2 OEM

Veronte can be provided in OEM version too. The total approximate weight is 90g.

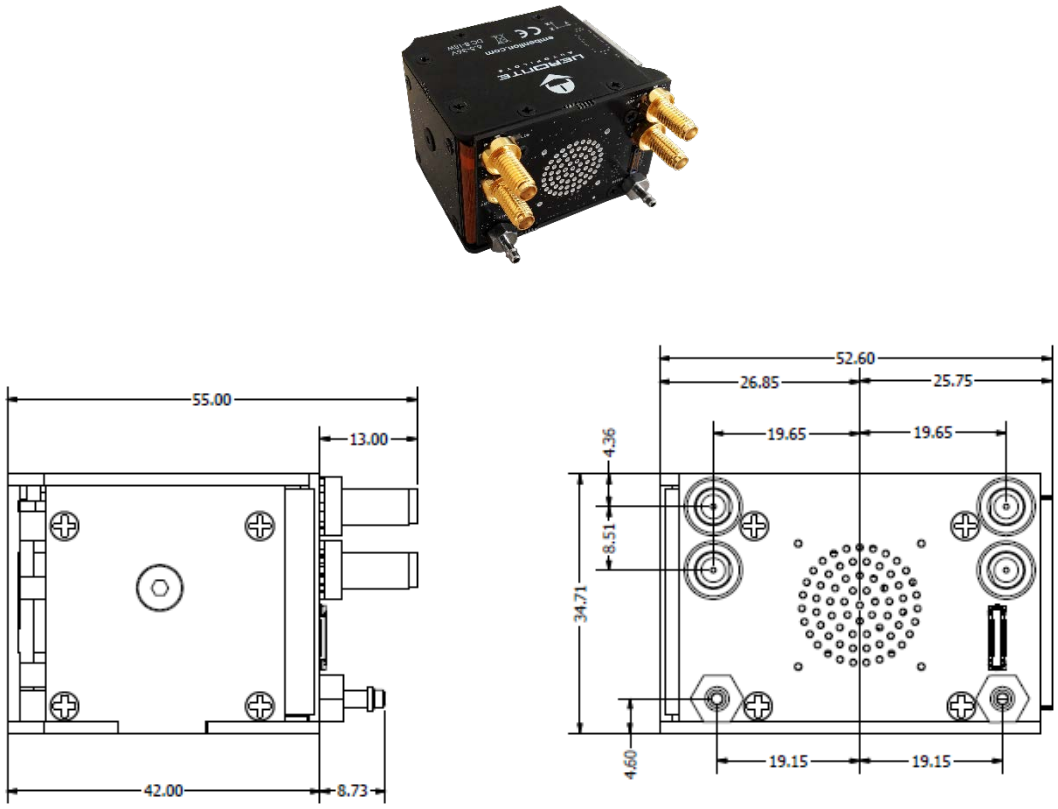


Figure 4: Veronte OEM dimensions (mm)

3.3 Mechanical Mounting

M4 screws are recommended for mounting.

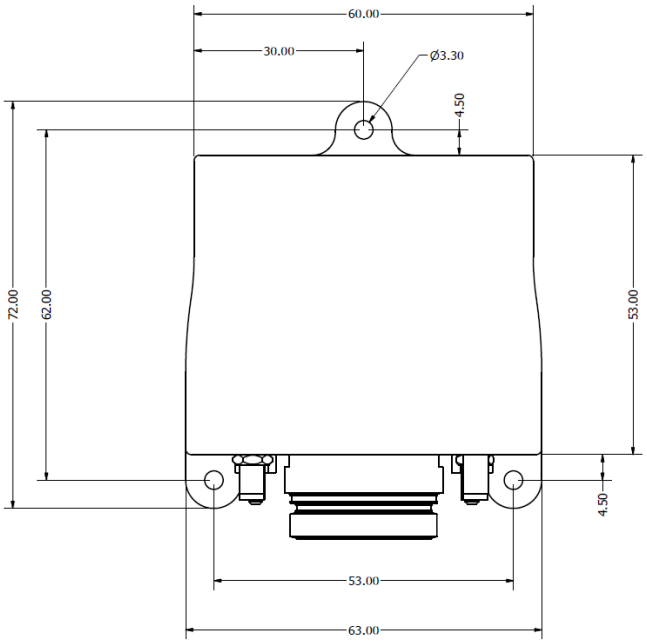


Figure 5: Veronte dimensions (mm)

3.3.1 Vibration Isolation

Although Veronte ultimately rejects noise and high-frequency modes of vibration with electronic filters and internal mechanical filters, there might be situation where external isolation components might be needed.

Veronte can be mounted in different ways in order to reject the airframe vibration. The simplest could be achieved by just using a double-sided foam tape on the bottom side of Veronte. Other ways may use some external structure which could be rigidly attached to the airframe and softly attached to Veronte (e.g. foam, silent blocks, αgel, etc…).

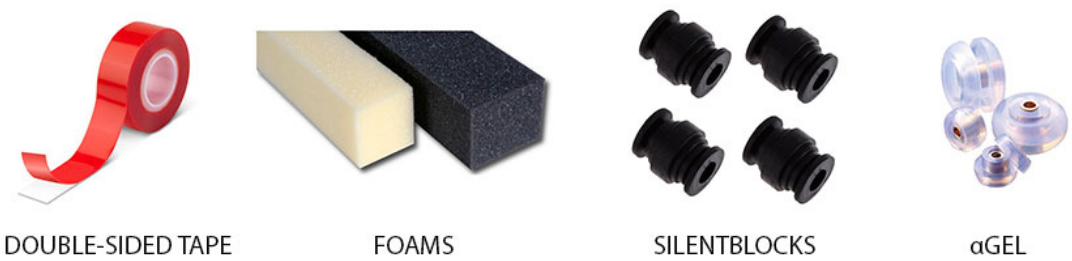


Figure 6: Veronte Mounts

The user should take into account that wiring should be loose enough so vibrations may not be transmitted to Veronte.
In cases where Veronte isolation is not viable, it is possible to use soft engine mounts. It is also recommended when there are other sensible payloads like video cameras or for high vibration engines.

3.3.2 Location

The location of Veronte has no restrictions. You only need to configure its relative position with respect to the centre of mass of the aircraft and the GPS antenna. The configuration of the location of Veronte can be easily configured using Veronte Pipe Software.

3.3.3 Orientation

The orientation of Veronte has no restrictions either. You only need to configure Veronte axes with respect to the aircraft body axes by means of a rotation matrix or a set of correspondences between axes. The configuration of the location of Veronte can be easily configured using Veronte Pipe Software.
Veronte axes are printed on the box and aircraft coordinates are defined by the standard aeronautical conventions.

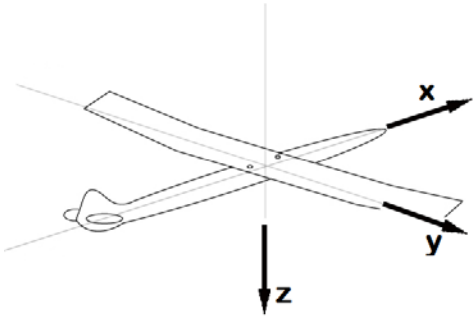


Figure 7: Aircraft Axis

3.4 Connector Layout

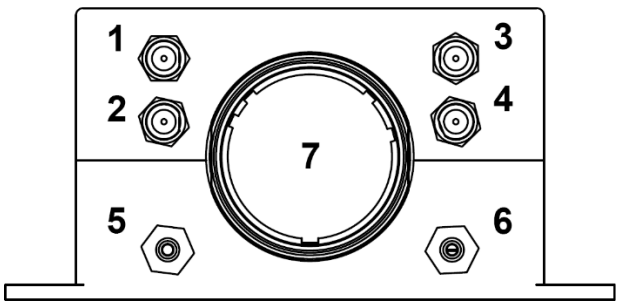


Figure 8: Veronte Connectors

Index	Connector
1	LOS SSMA connector
2	GNSS1 SSMA connector
3	M2M SSMA connector
4	GNSS2 SSMA connector
5	Static pressure port (Fitting 5/64in)
6	Dynamic pressure port (Fitting 5/64in)
7	68-pin connector

Table 1: Veronte connection panel

For both pressure ports, mating with clamped 2mm internal diameter flexible tubing is recommended.

3.5 Mating Connectors

Index	Connector	Mating Connector
1	RF antenna (SSMA Jack Female)	SSMA male Plug, low-loss cable is recommended.
2,4	GPS antenna (SSMA Jack Female)	SSMA male Plug, low loss cable is recommended. Active Antenna GPS: Gain min 15dB (to compensate signal loss in RF Cable) max 50dB, maximum noise figure 1.5dB, power supply 3.3V max current 20 mA
3	M2M antenna (SSMA Jack Female)	SSMA male Plug, low-loss cable is recommended.
7	Connector HEW.LM.368.XLNP	Mating connector P/N: FGW.LM.368.XLCT Mating harness is available on demand.

Table 2: Mating Connector Table

3.6 Antenna Integration

The system uses different kinds of antennas to operate that must be installed on the airframe. Here you can find some advices for obtaining the best performance and for avoiding antenna interferences.

Antenna Installation
• Maximize separation between antennas as much as possible. • Keep it far away from alternators or other interference generators. • Always isolate antenna ground panel from the aircraft structure. • Make sure that the antenna is securely mounted. • Always use high quality RF wires minimising the wire length. • Always follow the antenna manufacturer manual. • SSMA connections shall be tightened applying 1Nm of torque.
GPS Antenna
• Antenna top side must point the sky. • Install it on a top surface with direct sky view. • Never place metallic / carbon parts or wires above the antenna. • It is recommended to install it on a small ground plane.

Table 3: Antenna Installation

3.7 Pressure Lines

Veronte has two pressure input lines, one for static pressure to determine the absolute pressure and one for pitot in order to determine the dynamic pressure.
Absolute pressure connection on the aircraft is mandatory while pitot port can be obviated in some aircrafts. Pitot port absence must be configured on Veronte Pipe software.

Pressure Intake
• Pressure intakes must be located in order to prevent clogging. • Never install pressure intakes on the propeller flow. • Design pressure tubing path in order to avoid tube constriction.
Static Pressure
• It is not recommended to use inside fuselage pressure if it is not properly vented.
Pitot Tube
• Pitot tube must be installed facing the airflow in the direction of the "x" axis of the aircraft. • It is recommended to install it near the aircraft axis in order to avoid false measures during manoeuvres. • For low speed aircrafts it is recommended at least 6,3mm tubes for preventing rain obstruction.

Table 4: Pressure Intake Connect

4. Electrical

4.1 Power

Veronte can use unregulated DC (6.5V to 36V). Pins used for power and ground are the same for both Ground and Air configurations.
LiPo batteries between 2S and 8S can be used without regulation needs. Remaining battery can be controlled by the internal voltage sensor and by configuring the voltage warnings on the PC application.
For higher voltage installations, voltage regulators must be used. For dimensioning voltage regulators take into account that a blocked servo can activate regulator thermal protection.

> ⚠ **Caution!!** Power Veronte out of the given range can cause irreversible damage to the system. Please read carefully the manual before powering the system.

Veronte and servos can be powered by the same or different batteries. In case there are more than one battery on the system, a single point ground union it is needed to ensure a good performance. The ground signal should be isolated from other noisy ground references (e.g. engines). If all ground need to be connected, connection should be made on the negative pole of the battery.

It is recommendable to use independent switches for autopilot and motor / actuators. During the system initialization, PWM signal will be fixed to low level (0V), please make sure that actuators / motor connected support this behaviour before installing a single switch for the whole system.

4.2 Veronte I/O Signals

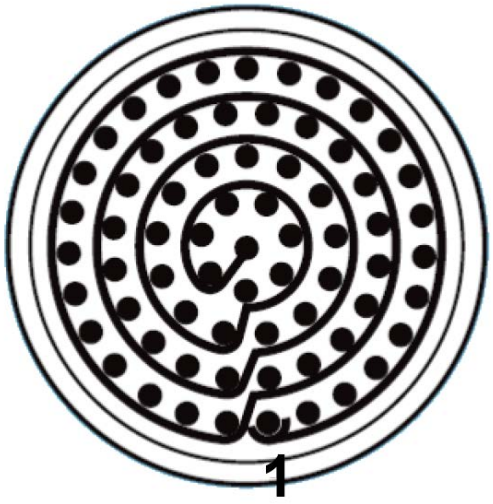


Figure 9: 68-pin redundant connector for Veronte Autopilot (frontal view)

			68-PIN CONNECTOR
PIN	**SIGNAL**	**TYPE**	**COMMENTS**
1	I/O1	I/O	PWM/DIGITAL OUTPUT/DIGITAL INPUT SIGNAL (0-3.3V)
2	I/O2	I/O	PWM/DIGITAL OUTPUT/DIGITAL INPUT SIGNAL (0-3.3V)
3	I/O3	I/O	PWM/DIGITAL OUTPUT/DIGITAL INPUT SIGNAL (0-3.3V)
4	I/O4	I/O	PWM/DIGITAL OUTPUT/DIGITAL INPUT SIGNAL (0-3.3V)
5	I/O5	I/O	PWM/DIGITAL OUTPUT/DIGITAL INPUT SIGNAL (0-3.3V)
6	I/O6	I/O	PWM/DIGITAL OUTPUT/DIGITAL INPUT SIGNAL (0-3.3V)
7	I/O7	I/O	PWM/DIGITAL OUTPUT/DIGITAL INPUT SIGNAL (0-3.3V)
8	I/O8	I/O	PWM/DIGITAL OUTPUT/DIGITAL INPUT SIGNAL (0-3.3V)
9	GND	GROUND	GROUND SIGNAL FOR ACTUATORS 1-8
10	I/O9	I/O	PWM/DIGITAL OUTPUT/DIGITAL INPUT SIGNAL (0-3.3V)
11	I/O10	I/O	PWM/DIGITAL OUTPUT/DIGITAL INPUT SIGNAL (0-3.3V)
12	I/O11	I/O	PWM/DIGITAL OUTPUT/DIGITAL INPUT SIGNAL (0-3.3V)
13	I/O12	I/O	PWM/DIGITAL OUTPUT/DIGITAL INPUT SIGNAL (0-3.3V)
14	I/O13	I/O	PWM/DIGITAL OUTPUT/DIGITAL INPUT SIGNAL (0-3.3V)
15	I/O14	I/O	PWM/DIGITAL OUTPUT/DIGITAL INPUT SIGNAL (0-3.3V)
16	I/O15	I/O	PWM/DIGITAL OUTPUT/DIGITAL INPUT SIGNAL (0-3.3V)
17	I/O16	I/O	PWM/DIGITAL OUTPUT/DIGITAL INPUT SIGNAL (0-3.3V)
18	GND	GROUND	GROUND SIGNAL FOR ACTUATORS 9-16
19	RS_232_TX	OUTPUT	RS-232 OUTPUT
20	RS_232_RX	INPUT	RS-232 INPUT
21	GND	GROUND	GROUND SIGNAL FOR BUSES
22	ANALOG_4	INPUT	ANALOG INPUT 0-3V

23	ANALOG_5	INPUT	ANALOG INPUT 0-3V
24	GND	GROUND	GROUND SIGNAL FOR BUSES
25	CANA_P	I/O	CANbus interface. It supports data rates up to 1 Mbps.
26	CANA_N	I/O	Twisted pair with a 120Ω Zo recommended
27	GND	GROUND	GROUND SIGNAL FOR BUSES
28	CANB_P	I/O	CANbus interface. It supports data rates up to 1 Mbps.
29	CANB_N	I/O	Twisted pair with a 120Ω Zo recommended
30	GND	GROUND	GROUND SIGNAL FOR BUSES
31	I2C_CLK	OUTPUT	CLK LINE FOR I2C BUS
32	I2C_DATA	I/O	DATA LINE FOR I2C BUS
33	GND	GROUND	GROUND FOR 3.3V POWER SUPPLY
34	3.3V	POWER	3.3V-100mA POWER SUPPLY
35	GND	GROUND	GROUND FOR 5V POWER SUPPLY
36	5V	POWER	5V-100mA POWER SUPPLY
37	GND	GROUND	GROUND FOR ANALOG SIGNALS
38	ANALOG_1	INPUT	ANALOG INPUT 0-3V
39	ANALOG_2	INPUT	ANALOG INPUT 0-3V
40	ANALOG_3	INPUT	ANALOG INPUT 0-3V
41	GND	GROUND	GROUND SIGNAL FOR FTS SIGNALS
42	FTS_OUT	OUTPUT	SIGNAL FROM COMICRO TO ACTIVAE SAFETY MECHANISM (0-3.3V)
43	FTS2_OUT	OUTPUT	SIGNAL FROM COMICRO TO ACTIVAE SAFETY MECHANISM (0-3.3V)
44	GND	GROUND	GROUND SIGNAL FOR SAFETY BUSES
45	V_ARB_TX	OUTPUT	VERONTE COMICRO UART OUTPUT TO ACTIVATE SAFETY MECHANISM
46	V_ARB_RX	INPUT	VERONTE COMICRO UART INPUT TO ACTIVATE SAFETY MECHANISM
47	GND	GROUND	GROUND SIGNAL COMICRO POWER SUPPLY
48	V_ARB-VCC	POWER	VERONTE COMICRO POWER (6.5 to 36V)
49	GND	GROUND	GROUND SIGNAL FOR BUSES
50	OUT_RS485_P	OUTPUT	NON-INVERTED OUTPUT FOR RS-485 BUS
51	OUT_RS485_N	OUTPUT	INVERTED OUTPUT FOR RS-485 BUS
52	IN_RS485_N	INPUT	INVERTED INPUT FOR RS-485 BUS
53	IN_RS485_P	INPUT	NON-INVERTED INPUT FOR RS-485 BUS
54	RS-485_GND	GROUND	GROUND FOR RS-485 BUS
55	EQEP_A	INPUT	ENCODER QUADRATURE INPUT A (0-3.3V)
56	EQEP_B	INPUT	ENCODER QUADRATURE INPUT B (0-3.3V)
57	EQEP_S	INPUT	ENCODER STROBE INPUT (0-3.3V)
58	EQEP_I	INPUT	ENCODER INDEX INPUT A (0-3.3V)
59	GND	GROUND	GROUND FOR ENCODERS
60	V_USB_DP	I/O	VERONTE USB DATA LINE
61	V_USB_DN	I/O	VERONTE USB DATA LINE
62	V_USB_ID	I/O	VERONTE USB ID LINE
63	V_USB_VCC	POWER	VERONTE USB POWER
64	V_USB_VCC	POWER	VERONTE USB POWER
65	GND	GROUND	VERONTE GROUND INPUT

66	GND	GROUND	VERONTE GROUND INPUT
67	VCC2	POWER	VERONTE POWER SUPPLY (6.5 to 36V)
68	VCC1	POWER	VERONTE POWER SUPPLY (6.5 to 36V)

Table 5: Veronte I/O interface

4.3 Harness colour code

68-PIN CONNECTOR		
PIN	COLOUR CODE	
1	WT	
2	BN	
3	GN	
4	YL	
5	GY	
6	PK	
7	BL	
8	RD	
9	BK	
10	VT	
11	GY	PK
12	RD	BL
13	WT	GN
14	BN	GN
15	WT	YL
16	YL	BN
17	WT	GY
18	GY	BN
19	WT	PK
20	PK	BN
21	WT	BL
22	BN	BL
23	WT	RD
24	BN	RD
25	WT	BK
26	BN	BK
27	GY	GN
28	YL	GN
29	PK	GN
30	YL	PK
31	WT	
32	BN	
33	GN	

Description		
BK	Black	Negro
BL	Blue	Azul
BN	Brown	Marron
GN	Green	Verde
GY	Gray	Grís
OR	Orange	Naranja
PK	Pink	Rosa
RD	Red	Rojo
VT	Violet	Violeta
WT	White	Blanco
YL	Yellow	Amarillo

34	YL	
35	GY	
36	PK	
37	BL	
38	RD	
39	BK	
40	VT	
41	GY	PK
42	RD	BL
43	WT	GN
44	BN	GN
45	WT	YL
46	YL	BN
47	WT	GY
48	GY	BN
49	WT	PK
50	PK	BN
51	WT	BL
52	BN	BL
53	WT	RD
54	BN	RD
55	WT	BK
56	BN	BK
57	GY	GN
58	YL	GN
59	PK	GN
60	YL	PK
61	WT	
62	BN	
63	GN	
64	YL	
65	GY	
66	PK	
67	BL	
68	RD	

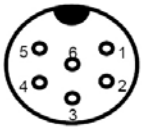
Table 6: Colour code

4.4 Joystick

To use the joystick in the system, connect the PPMout of the trainer port to a digital input of Veronte and configure that digital input as the radio input in Pipe.
If the PPM level is 3.3V, pins 1-8, 10-17 and 55-58 pins can be used.

Veronte is compatible with standard Pulse Positon Modulation (PPM) signals, Futaba radios between 8 and 12 channels are recommended.

Pin	Designation
SHIELD	GROUND
1	$V_{ENCODER}$
2	PPM_{OUT}
3	PPM_{IN}
4	V_{ENC2}
5	$V_{BATTERY}$
6	UNKNOWN



Pin	Designation
1	NC
2	GROUND
3	PPM_{OUT}
4	$V_{BATTERY}$
5	$V_{ENCODER}$
6	PPM_{IN}

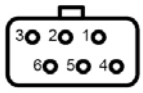


Figure 10: Futaba T10 Joystick

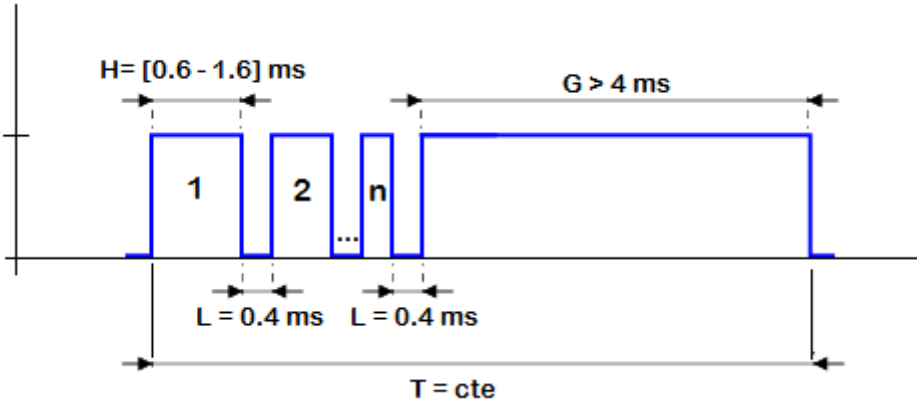


Figure 11: PPM Signal

As default, channel 8 is reserved for manual / auto switch. High level is used for automatic flight and low level for manual control. This channel can be configured on Veronte Pipe.

⚠ **Caution!!** PPM signal must be into the Veronte voltage ranges. Some joysticks may need an adaptation board, please ask our team to check compatibility.

Veronte connector for CS is provided with 3.5mm stereo plug connector as follows:

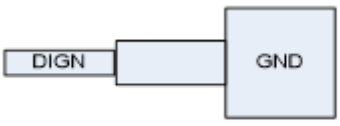


Figure 12: PPM connector

4.5 OEM Board Pinout

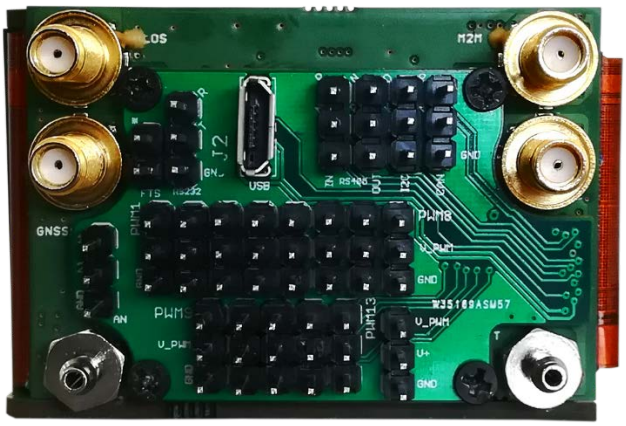


Figure 13: OEM Board

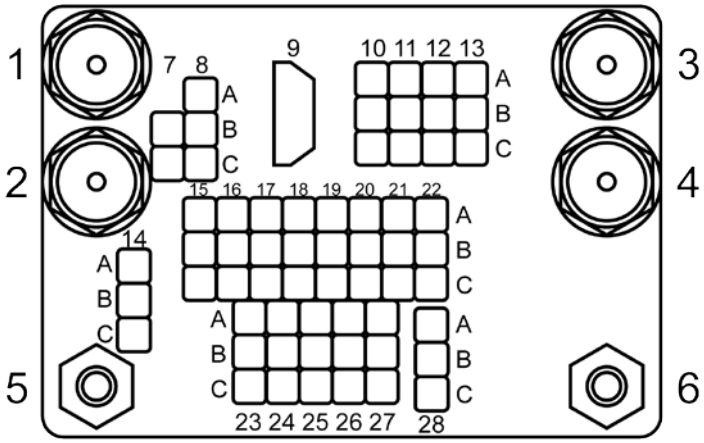


Figure 14: Pinouts for OEM Board

PINOUT	SIGNAL	TYPE	COMMENTS
1			LOS SSMA CONNECTOR
2			GNSS1 SSMA CONNECTOR
3			M2M SSMA CONNECTOR
4			GNSS2 SSMA CONNECTOR
5			STATIC PRESSURE PORT (FITTING 5/64IN)
6			DYNAMIC PRESSURE PORT (FITTING 5/64IN)
7C to 28C	GND	GROUND	GROUND SIGNAL
7B	FTS_OUT	O	SIGNAL FROM COMICRO TO ACTIVAE SAFETY MECHANISM (0-3.3V)
8A	DSPRX_232_D	I	RS-232 INPUT
8B	DSPTX_232_D	O	RS-232 OUTPUT
9	J2	I/O	microUSB CONNECTOR

10A	IN_485_P	I	NON-INVERTED INPUT FOR RS-485 BUS
10B	IN_485_N	I	INVERTED INPUT FOR RS-485 BUS
11A	OUT_485_N	O	INVERTED OUTPUT FOR RS-485 BUS
11B	OUT_485_P	O	NON-INVERTED OUTPUT FOR RS-485 BUS
12A	SDA_A_OUT	O	DATA
12B	SCL_A_OUT	O	CLK
13A	CANA_P	I/O	CANbus interface. It supports data rates up to 1 Mbps. Recommended cable is a twisted pair with a 120Ω Z_o.
13B	CANA_N	I/O	
14A	ANALIN_1	I	ANALOG INPUT 0-3V
14B	ANALIN_2	I	ANALOG INPUT 0-3V
15A to 27A	PWM1 to PWM13	I/O	PWM/DIGITAL OUTPUT/DIGITAL INPUT SIGNAL (0-3.3V)
15B to 27B	V_PWM	I	Servo power (if actuators have an independent battery)
28A	V_PWM	I	Servo power (if actuators have an independent battery)
28B	V+	I	6.5 to 36 V

Table 7: OEM board pinout

5. Performances

Variable	Value
Weight (with enclosure and connector)	190g
Weight (OEM)	90g
Voltage Input	6.5V to 36V
Power Input	5W without M2M 9W with 3.75G M2M 15Wmax with 2G M2M
Minimum Temperature	-40ºC
Maximum Temperature	+55ºC[1]
Max. Internal Temperature	+85ºC
Minimum Pressure	0kPa
Maximum Pressure	104kPa
Maximum Dynamic Pressure	6kPa [2]
Protection Rating	IP67 enclosure version
Acceleration Limits (3 axes)	±2g to ±16g [3]
Angular Velocity Limits (3 axes)	±125deg/s to ±2000deg/s[4]
Magnetic Field Limits (3 axes)	±4 to ±16 Gauss
GPS	72 channels, GPS L1C/A, GLONASS L1OF, BeiDou B1I
Datalink	410 to 480 MHz licensed or FHSS 902-928MHz FHSS 2.4 to 2.483 GHz ISM Band 869.5-869.75 MHz ISM Band

Table 8: Veronte performances

[1] No convection, ask for increased limits (up to 71ºC)
[2] Ask for increased limits (up to 50kPa)
[3] Limit for sustained maneuvers. Transitional higher accelerations are possible (e.g. catapult launch). Ask for increased limits.
[4] Limit for sustained maneuvers. Transitional higher angular velocities are possible. Ask for increased limits.