MILLSWOOD engineering

ServoStation UAV

PRODUCT MANUAL

General Description

The ServoStation UAV is a 6V / 10A servo power supply that can operate directly from up to 42VDC. It has been designed to cater for the demands of unmanned aircraft, but may also find application in larger recreational model aircraft.

Particular attention has been paid to efficiency, reliability, vibration resistance, interfacing and ease of installation.

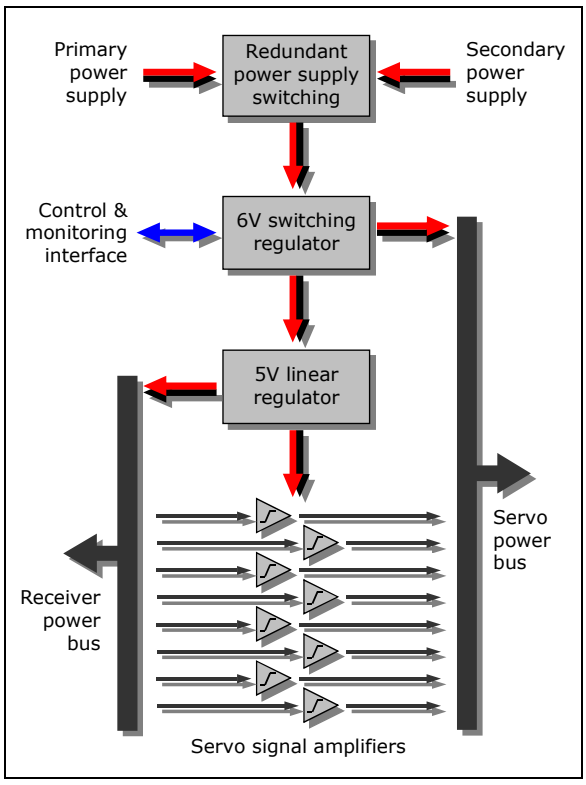
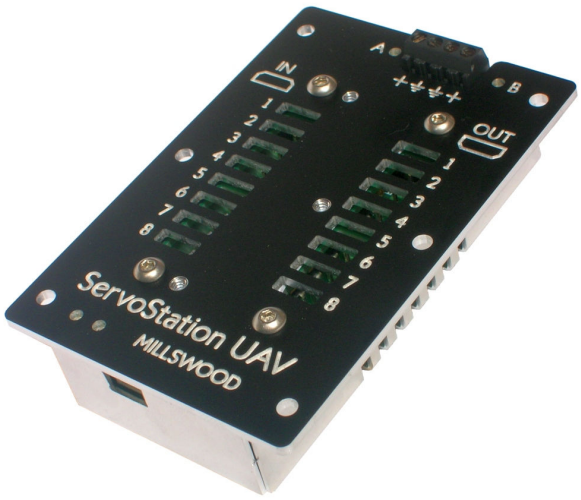


Fig. 1: ServoStation UAV block diagram



Features

- High current switching servo power supply: 10 Amps continuous; 12 Amps short-term.
- Operates directly from any voltage from 8 to 42VDC – i.e. 3 to 10S Lipos, 12 and 28V avionics busses, etc.
- Dual (isolated) power inputs with automatic low-loss FET switching between the two
- Power inputs reverse polarity protected and able to withstand transients to +65V
- Control and monitoring interface includes:
  - Remote shutdown
  - Low-voltage cutout override
  - Servo bus current and voltage monitoring
  - Over-current alarm
- 8 servo channels, each with its own servo signal amplifier
- Operating temperature range: -40 to +70°C
- Aluminium enclosure with front panel mounting flange and servo connector locking device

Installation

The ServoStation UAV has 4 main points of connection: power inputs, servo inputs, servo outputs and the control & monitoring interface. The first 3 must be wired up correctly, but use of the control & monitoring interface is entirely optional; the device will function quite normally without connecting anything to it.

Power inputs

The ServoStation UAV has 2 power inputs marked A and B – at least one of these inputs must be provided with a voltage between 8 and 42VDC. A minimum of 9VDC must be applied for the ServoStation UAV to start operating, but once up and running it will continue to operate down to 8V.

Strip the ends of the power cables to expose 5mm of wire. The terminal blocks can accept wire gauges from AWG16 to AWG28, but AWG18 to AWG20 is recommended. Do not tin the wires.

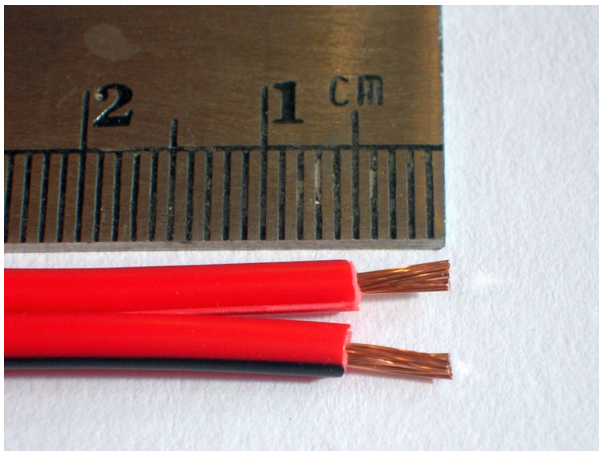


Fig. 2: Power cables stripped to 5mm

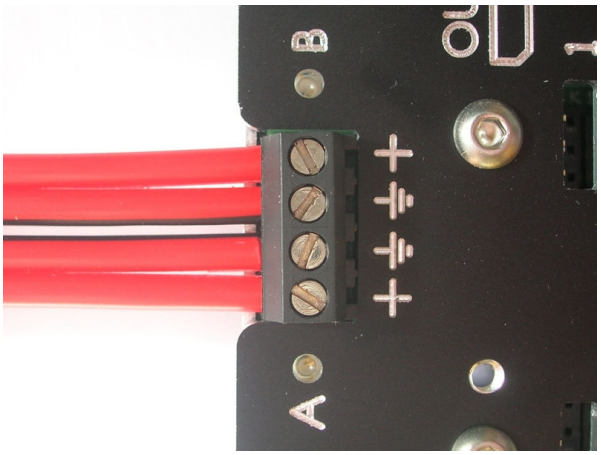


Fig. 3: Power cables installed

Insert the power cables into the terminal blocks with polarity as marked and ***firmly*** tighten the screws. Make sure that the insulation goes all the way to the terminal blocks – there should be no exposed wire visible. Ensure sure that no strands of wire have separated which could come into contact with adjacent wires or the metal housing. Secure the power cables so that they exit the terminal blocks at right angles, and are not subjected to tension or repeated flexing. Do not attempt to insert live wires into the terminal blocks.

Servo inputs

The 8 servo inputs are located down the left-hand side of the front panel. Insert as many female-female servo cables as required to connect the outputs from your autopilot or receiver to the inputs of the ServoStation UAV.

5VDC is supplied on each of these connections to power the autopilot or receiver. ***Note that the 5V rail is derived from the 6V rail, and if the 6V rail is compromised then the 5V rail will also be affected.***

The orientation of the servo connectors is shown on the front panel.

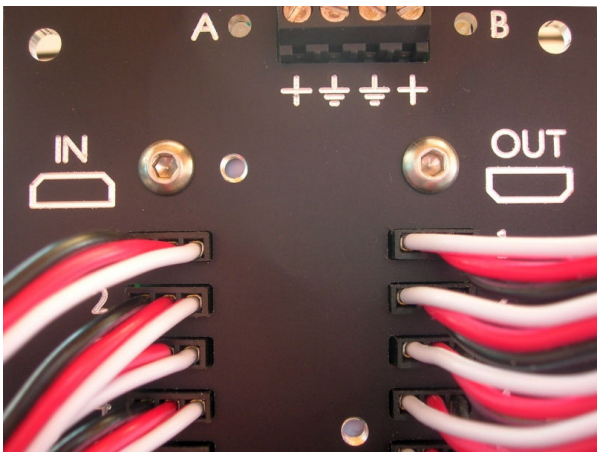


Fig. 4: Servo cables installed

Servo outputs

The 8 servo outputs are located down the right-hand side of the front panel. 6VDC is supplied on each of these connections to power the servos. The orientation of the servo connectors is shown on the front panel; note that they are rotated 180° compared with the servo inputs.

Servo connector locking device

Standard servo connectors have no locking mechanism and can become loose and fall out during flight, and so a locking device is included with the ServoStation UAV to prevent this. It consists of a red Perspex plate with individual stepped recesses to clamp the connector housings down.

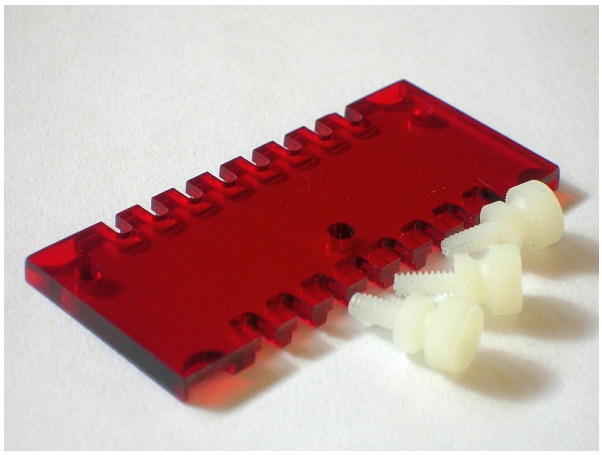


Fig. 5: Servo connector locking device

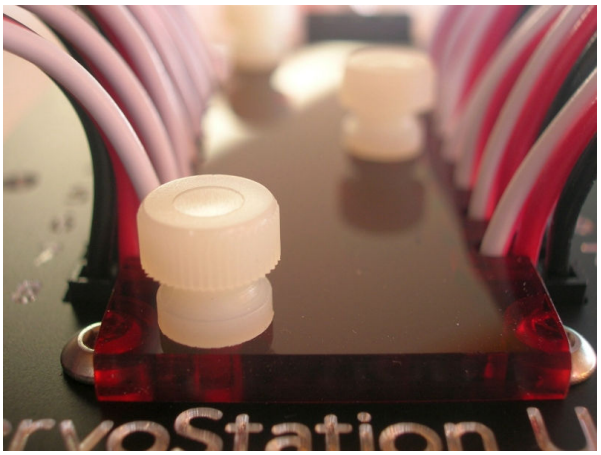


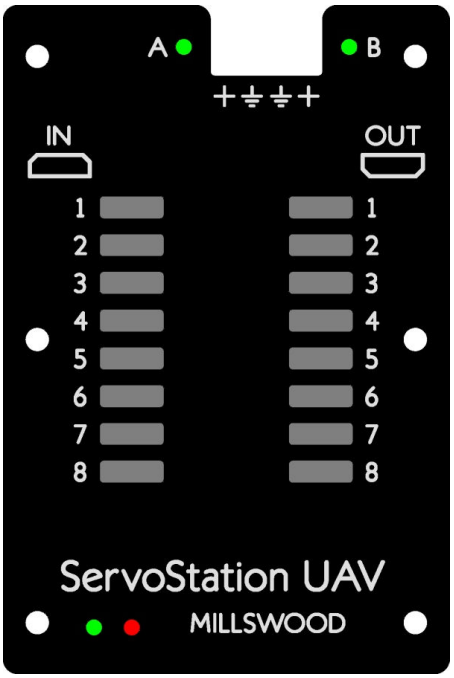
Fig. 6: Locking device installed

The locking plate is secured to the front panel with 3 nylon thumbscrews once all the servo cables have been installed. Cables should be neatly and securely dressed on exit from the locking device to prevent chafing.

LED Indicators

There are 4 LEDs on the front panel:

- The 2 green LEDs labelled "A" and "B" (located next to the power supply inputs) indicate the presence of power on the adjacent power inputs. These LEDs are a useful check for wiring continuity in redundant systems, as failure of the secondary power supply is not always obvious.
- The green LED along the bottom of the front panel illuminates when the ServoStation UAV is on.
- The red LED along the bottom of the front panel illuminates when the total servo current exceeds 9 Amps. There is at least another 33% of reserve capacity when the red LED comes on, so occasional flickering of this LED is not a cause for concern.



Control & Monitoring Interface

The control & monitoring interface connector is located behind the front panel, just below the Millswood logo. A pre-wired mating connector is supplied with the ServoStation UAV. A black wire is used for the ground connection (pin 1).

The simplest and probably most useful function provided by the control & monitoring interface is the ability to turn the ServoStation on and off without disconnecting the power.

To implement remote shutdown simply connect a switch between pins 1 and 3; closing the switch turns the ServoStation UAV off.

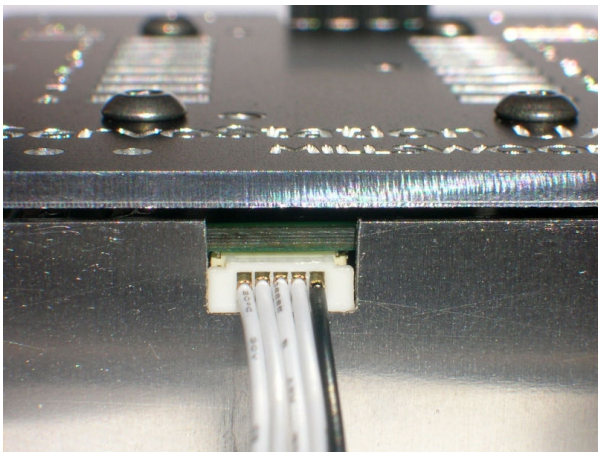


Fig. 7: Control & monitoring interface

Summary of pin functions

Pin number	Pin name	Brief description
1	Ground	
2	Over-current alarm output	Active low when current > 9 Amps
3	Remote shutdown input	Low to shutdown; high to force on
4	+6V output	700mA max.
5	Current monitor output	Gain = 1mA / Amp

Table 1: Control & monitoring interface pin functions

Pin functions in detail

Pin 1: Ground (black wire)
All grounds are connected together internally, including this one. The case is also grounded internally.

Pin 2: Over-current alarm output
The over-current alarm is an active low output that is asserted whenever the total servo current exceeds 9 Amps. It is intended for use as a microprocessor interrupt. It is suitable for direct connection to either 3.3 or 5V systems, but with 3.3V systems a protection diode to the 3.3V rail is recommended.

Pin 3: Remote shutdown input
The remote shutdown input has several functions. As noted previously the simplest use is to connect it to a switch, with the other switch terminal connected to ground. Closing the switch turns the ServoStation UAV off. If more than one ServoStation UAV is used, multiple remote shutdown connections can be wired together to the same switch ***provided that the ServoStation UAVs all share identical power supplies (both A and B)***. If they have different power supplies, then separate switches (or a multi-pole switch) must be used.

The remote shutdown input can also be used to override the internal low-voltage cutout. If a voltage greater than 1.5V is applied to this input, then the ServoStation UAV will do its best to continue operating regardless of how low the power supply voltage becomes. ***Operating at low input voltage and high output current may cause permanent damage to the ServoStation UAV, and should generally be avoided.***

Do not connect the remote shutdown input to the +6V output (pin 4) – this will cause a stalemate on power-up and the ServoStation UAV will never start up. A forward-biased diode

connected from the +6V output to the remote shutdown input will allow start-up and prevent shutdown.

Pin 4: +6V output
The +6V output may be used to power other devices, or to monitor the servo rail. Note that this output is connected directly to the 6V servo power bus, and will therefore be electrically noisy. It should be filtered if used.

Pin 5: Current monitor output
The current monitor output sources a current that is proportional to the total servo current. A current source was chosen over a voltage source because current sources provide superior noise immunity and more flexible interfacing. The current source has a gain of 1mA per Amp, and so a 330 Ohm resistor connected from this output to ground will generate 0 – 3.3V, corresponding to 0 – 10 Amps. The resistor value chosen should be ***less than*** 450 Ohms to avoid saturating the current source (unless range is to be traded for sensitivity). For best noise immunity the resistor should be located as near as possible to the ADC.

Absolute Maximum Ratings[Note 1]

Symbol	Parameter	Min	Max	Unit
V_{SUPPLY}	Power supply voltage	-45	+45	V
V_{PWM_IN}, V_{PWM_OUT}	PWM input & output voltages, control & monitoring output voltages	-0.5	+7	V
V_{5V_OUT}	5V output voltage	-0.5	+7	V
V_{6V_OUT}	6V output voltage	-0.3	+10	V
V_{RS_IN}	Remote shutdown input voltage	-8.0	+20	V
V_{ESD}	ESD rating as per Mil-Std-883C, method 3015, using the human body model[Note 2]	2		kV
T_{stg}	Storage temperature range	-40	+85	°C

Note 1: Absolute maximum ratings are those values beyond which damage to the product may occur. Functional operation under these conditions is not implied (or recommended).

Note 2: The human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin.

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
V_{SUPPLY}	Power supply voltage[Note]	+8	+42	V
T_{op}	Operating temperature range	-40	+70	°C

Note: The minimum power supply voltage has 1V of hysteresis. A minimum of 9V is required for the ServoStation UAV to turn on, but once operating the input voltage range extends down to 8V.

Electrical Characteristics

Test conditions are $+8<V_{BI}<+42V$, $-40<T_{op}<+70°C$ unless stated otherwise.
Where given, typical values apply to operation at +21°C unless stated otherwise.

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
I_{Q_ON1}	Quiescent current of active power supply input	Shutdown input left open-circuit or tied > 1.5V			40	mA
I_{Q_ON2}	Quiescent current of secondary (inactive) power supply input	Shutdown input left open-circuit or tied > 1.5V			2	mA
I_{Q_SHDN}	Quiescent current in shutdown, either input	Shutdown input = 0V			2	mA
Servo power output						
V_{SPO}	Voltage		5.8	6.0	6.2	V
ΔV_{SPO}	Line regulation	V_{BI}=+8V to +42V	unmeasurable***Note 1***			mV
ΔV_{SPO}	Load regulation	I_{SPOT}=0.1A to 10A		20	50	mV
I_{SPOT}	Total current capability***Note 2***		10.0			A
I_{SPOI}	Individual current capability***Note 3***		3.0			A
I_{SPOP}	Peak current capability	Max. of 1 minute every 10 minutes	12.0			A
I_{SPOSC}	Short circuit current		14.0	14.5	15.0	A
$V_{SPORp-p}$	Peak-to-peak voltage ripple	Non-inductive load		50	200	mV
η	Switching power supply efficiency	2.5A<I_{SPOT}<10A	85	90		%
f	Switching frequency		250	275	300	kHz
Receiver power output						
V_{RPO}	Voltage		4.8	5.0	5.2	V
ΔV_{RPO}	Line regulation	V_{BI}=+8V to +42V	unmeasurable***Note 1***			mV
ΔV_{RPO}	Load regulation	I_{RPO}=5mA to 1A		10	25	mV
I_{RPO}	Current capability		1.0			A
I_{RPOSC}	Short circuit current			1.8	2.2	A
$V_{RPORp-p}$	Peak-to-peak voltage ripple	Non-inductive load		15	50	mV
Servo pulse amplifiers						
I_{IL}	Input leakage current	V_{SI}=0 or 5.0V			120	µA
V_{IL}	Input logic low		0		0.8	V
V_{IH}	Input logic high		2.0		5.0	V
V_{OL}	Output logic low	Sink current=50µA Sink current=24mA			0.1 0.5	V
V_{OH}	Output logic high	Source current=50µA Source current=24mA	4.7 4.0			V
t_P	Propagation delay	C_L=50pF	1.0		8.5	ns

Note 1: Change in output voltage is below noise floor.
Note 2: Current drawn from 5V rail subtracts from this value.
Note 3: Limited by connector current rating.

Typical Performance Characteristics

Test conditions are $+8<V_{BI}<+42V$, $T_{op}=+21°C$ unless stated otherwise.

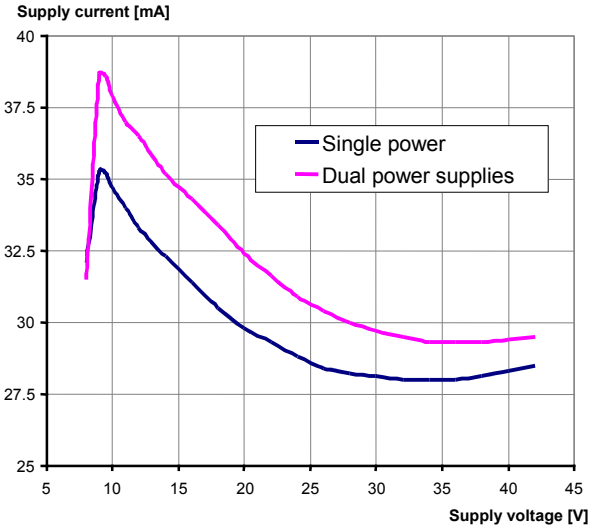


Fig. 8: Quiescent supply current

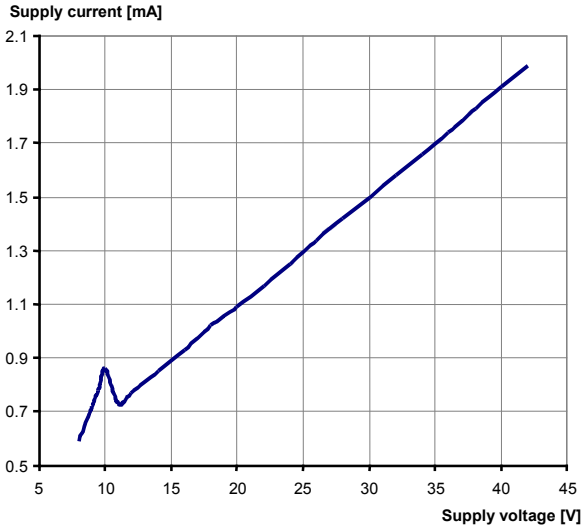


Fig. 9: Shutdown supply current

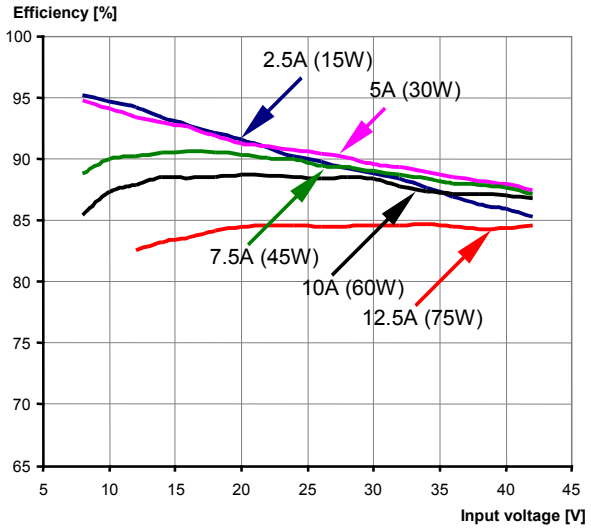


Fig. 10: Efficiency versus supply voltage for various total output currents

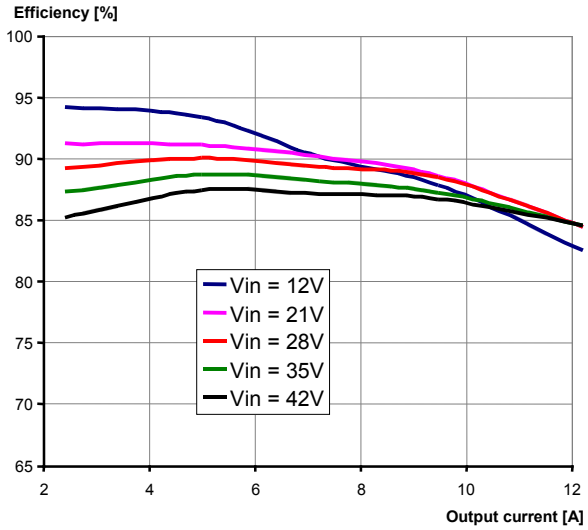


Fig. 11: Efficiency versus total output current for various supply voltages

In a redundant power supply configuration, the current drawn from the inactive power supply is the same as the current drawn in shutdown.

Mechanical Data

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
L	Length			90		mm
W	Width			60		mm
H	Height	Excluding power connector Including power connector and bolt heads		21.0 27.5		mm
M	Mass	Including servo connector locking device and control & monitoring interface cable		105		g

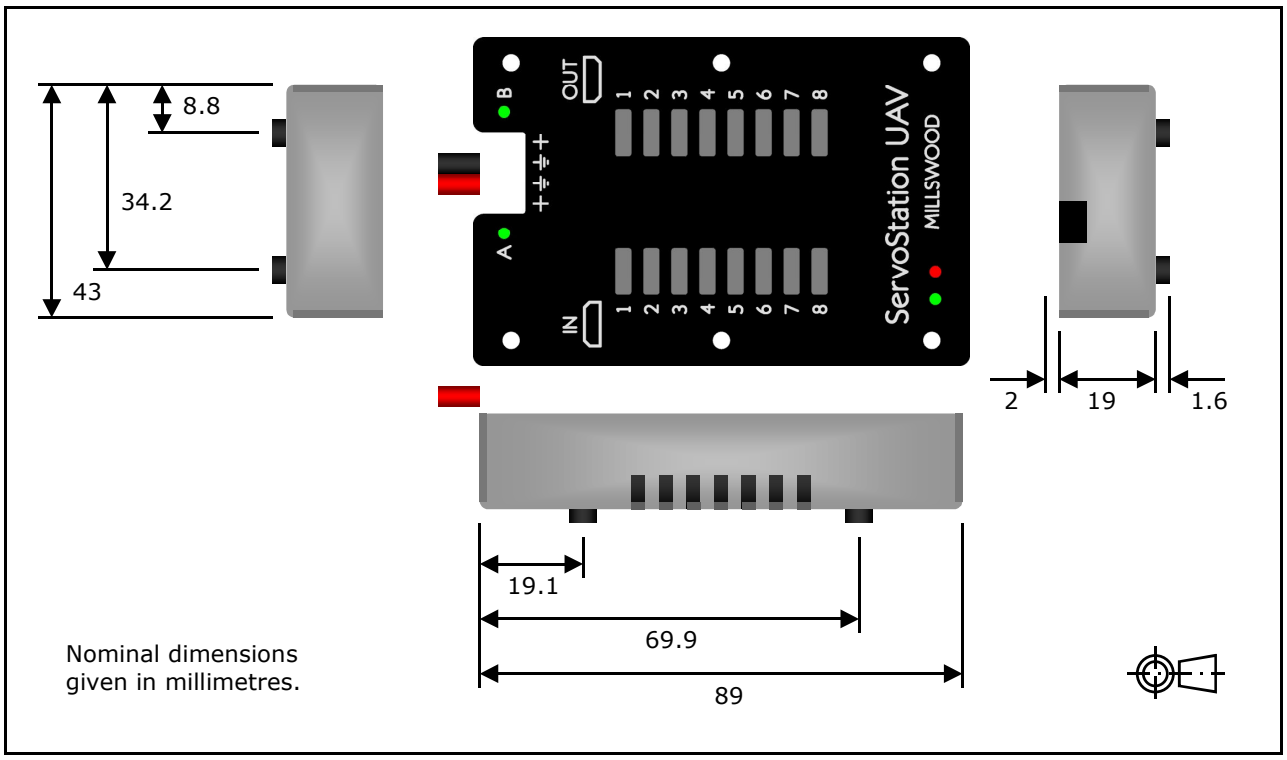


Fig. 13: Physical dimensions

Further Information

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