

100 W GENERATOR POWER UNIT

USER MANUAL 1.6



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1. Description

100 W Generator Power Unit (GPU) is designed to provide onboard dual voltage regulated power supply for the unmanned aircraft vehicles.

Despite small size, power unit offers outstanding efficiency as well as unique features such as the ability to monitor load, battery current, engine rpm, generator and battery voltage through TTL serial communication. All power distribution parameters can be transmitted to the ground station and monitored during the flight.

Generator power unit can be used with brushless or brushed generators that have a voltage output within 10-35 Volts and 13-50 Volts respectively. Integrated Lithium Polymer charger is used for the backup battery, which is switched on during the pre-flight checks, power peaks, or in the event of the engine failure.

Power unit is packed in a sealed aluminum enclosure and fitted with the high-end industrial push-pull connectors. Fan assisted cooling option is available.

Please contact for customized solutions.

2. Key Features

- Light weight, small and efficient
- 13 V to 50 V input range
- 100 W continuous load
- Compatible with brushed or brushless generators
- 6 V and 12 V output
- Load current up to 10 A
- Short circuit protection
- Battery backup connection
- 3 cell Li-Poly integrated charger
- External power connection
- Integrated current sensors
- TTL connection
- IP 64 housing, IP 68 on request



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Electrical Specifications

Brushed generator voltage range	13 – 50 V
Brushless generator voltage range	10 – 35 V
External power supply voltage range	13 – 50 V
Battery Type	3 cells, Lithium Polymer
Battery Voltage	12.6 V
Maximum battery charging current	2 A
Maximum continuous generator input current	8 A
Maximum continuous battery input current	8 A
Maximum continuous external power current	8 A
Output voltage	6 V and 12 V
Maximum output voltage ripple	200 mV@6V 400mV@12V
Continuous load current, 6 Volt output ¹	5A
Continuous load current, 12 Volt output ¹	6A
Maximum peak load current	10 A for 10 seconds
Efficiency of 6 Volt output	85% typical
Efficiency of 12 Volt output	90% typical
No load GPU current	110 mA
Tachometer range ²	1000-90000 rpm
Tachometer accuracy	200 rpm
Current sensor range	0 to 10 A
Current sensor accuracy	0.2 A
Voltage sensor accuracy	0.1 V
Serial Communication	5V TTL

Mechanical Specifications

Dimensions	59.4 x 115.8 x 32.4 mm
Weight (with conductive enclosure)	190 grams
Cooling method	Conductive or fan-assisted
Maximum enclosure temperature	70°C
Environmental protection	IP 64 standard, IP 68 on request
Operating temperature	- 40°C to +50°C ¹
Electrical connectors	Fischer 104 Series push-pull connector

¹ Enclosure temperature must not exceed 70 °C, additional cooling may be required

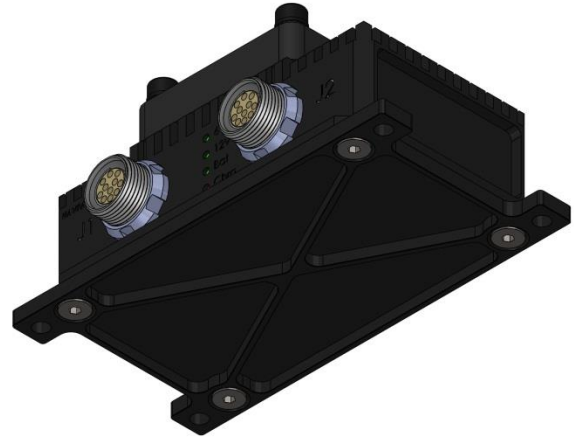
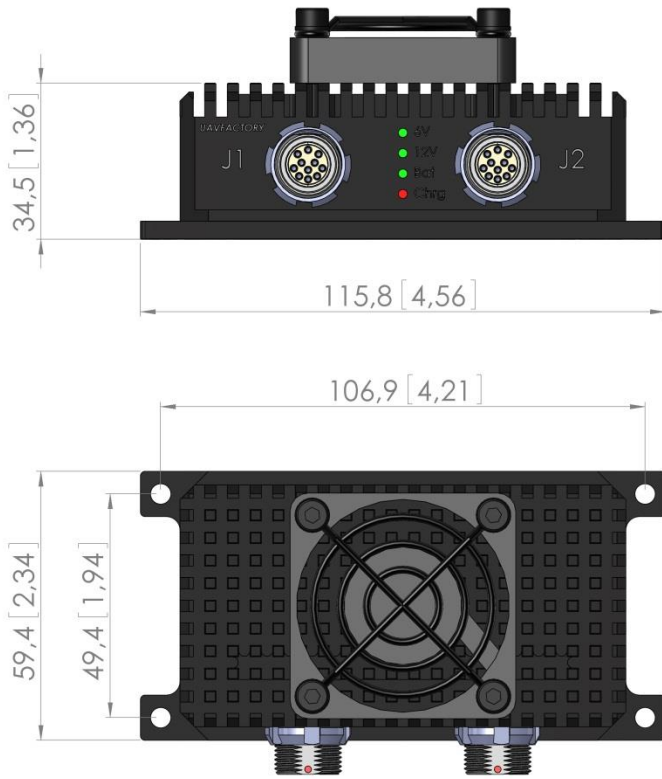
² The tachometer range is valid for serial number starting from GPU0042

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3. Performance

The GPU performance graphs are presented below. Efficiency for the 6 V output against the input voltage is shown in Figure 1, efficiency for 12 V output is shown in Figure 2.

The maximum continuous power of the GPU is dependent on the ambient temperature and the ability to dissipate heat generated by the GPU. The maximum continuous power to ambient temperature relation is shown in Figure 3. At no circumstances operating GPU enclosure temperature should reach 70° C.

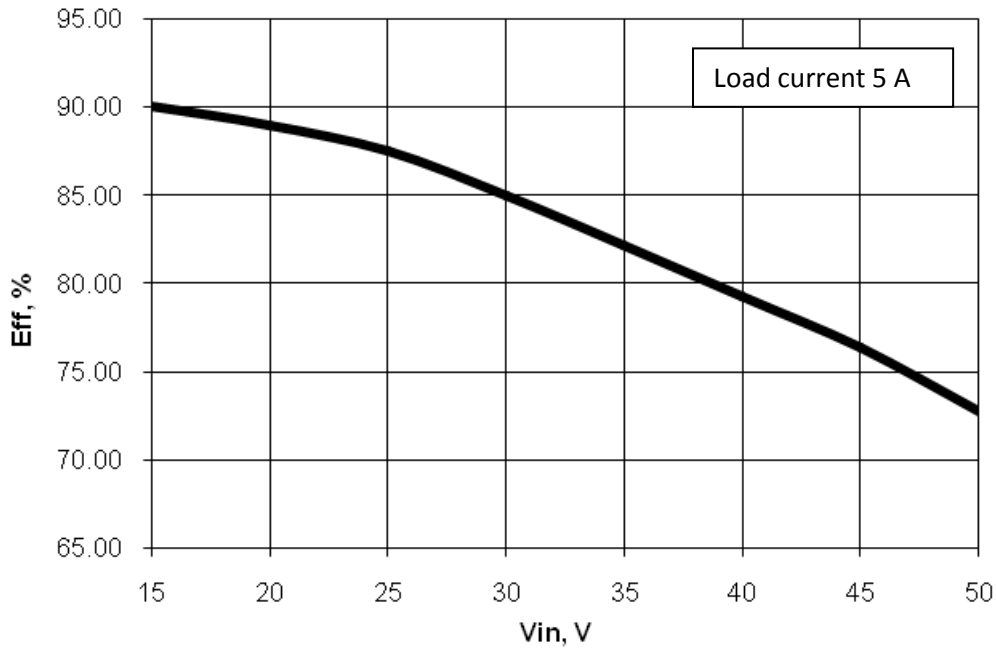


Figure 1 Efficiency at 6 Volt output vs input voltage

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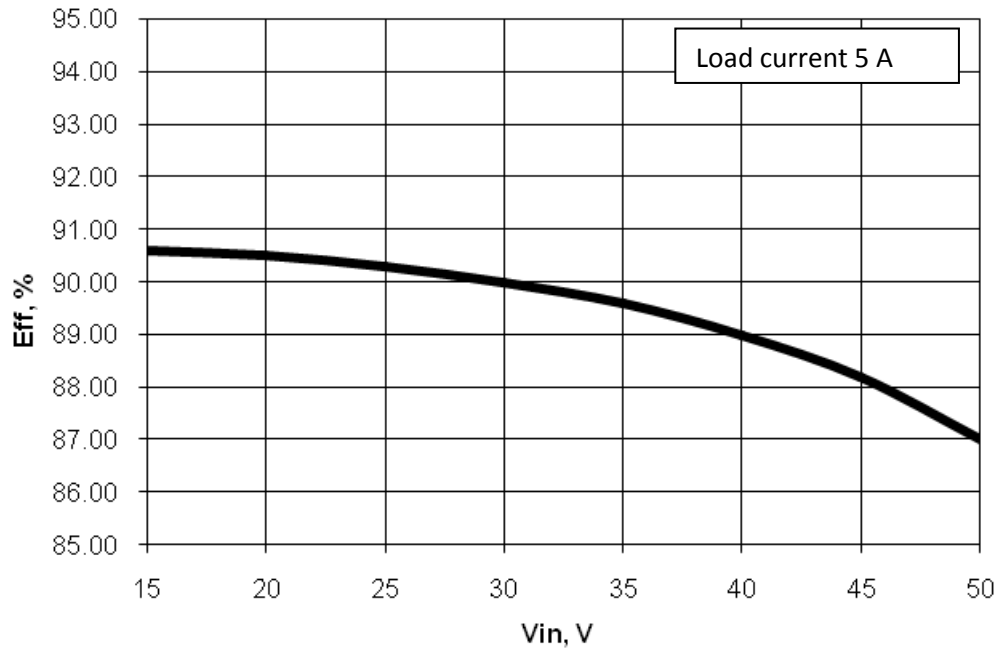


Figure 2 Efficiency at 12 Volt output vs input voltage

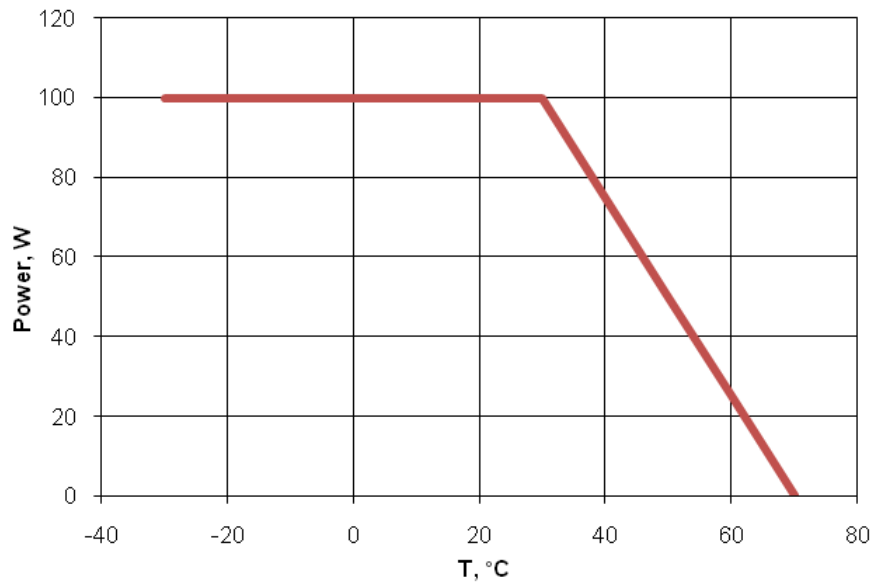


Figure 3 Allowable continuous power depending on ambient temperature

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4. Generator

GPU is available in brushed or brushless versions. In the brushed GPU version, the brushed generator's voltage output must be within 13-50 V range. If the voltage out is below 13 V, GPU will automatically switch to battery source.

In the brushless GPU version, the 3-phase rectifier is used between the generator and the internal DC-DC converter of the GPU (refer to Figure 5). Therefore DC voltage at the DC-DC converter is equal to rectified value of generator's AC voltage. In this case generator's line voltage RMS value must be within 10 - 35V range. Line voltage RMS value can be measured between any two leads of the generator. If the voltage out is below 10 V, GPU will automatically switch to battery source

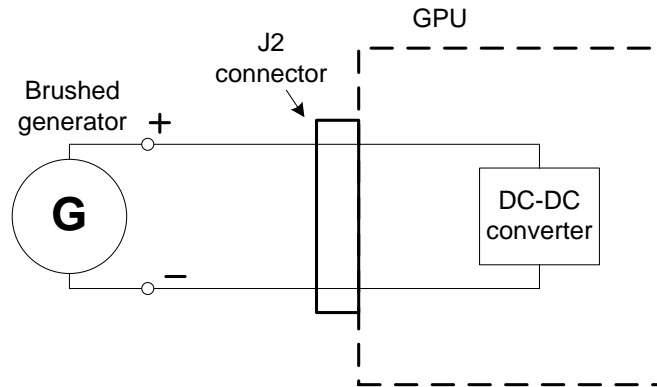


Figure 4 Brushed generator and GPU internal connection

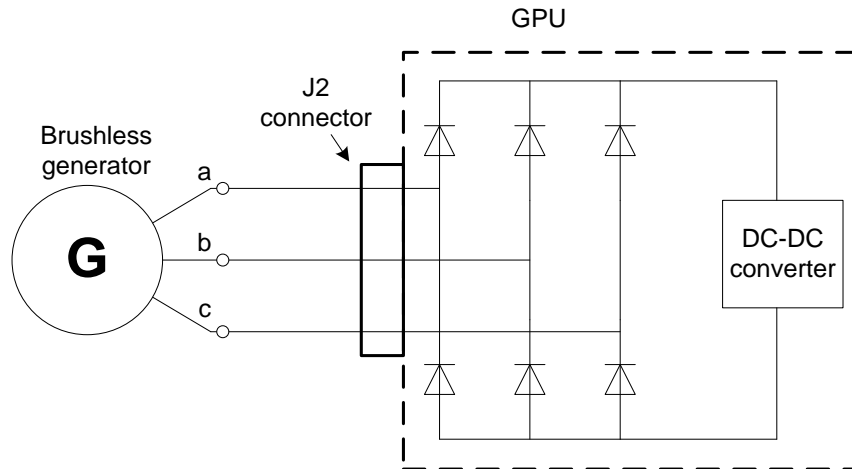


Figure 5 Brushless generator and GPU internal connection



GPU can be used for both - brushed and brushless generators. Please state the required generator type in your order. The typical connection diagram for the brushless and brushed generator systems is shown in Figure 7 and Figure 8 respectively.

GPU can be used both with inline generators and geared generators. An example of a belt-driven generator is shown in Figure 6. The ratio between the pulleys is chosen to keep the GPU input voltage under the 50 V limit

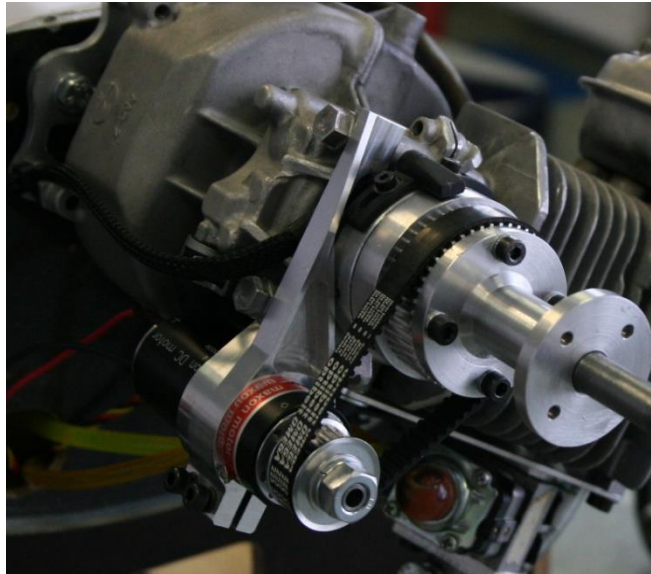


Figure 6 Belt-driven onboard generator example

In many cases, at low engine rpm, the voltage generated is less than 13 V, which means that the onboard battery will be used for powering the unmanned aircraft systems. This is not an issue, since aircraft do not generally fly at low idle settings for extended periods of time and the power requirements can be met by the onboard battery. The onboard battery capacity needs to be calculated depending on actual mission profile of the UAV, taking into account possible aircraft descend time as well as desired pre-flight operation time- please see section 10 for more details and battery capacity estimation formula. Please use adequate safety factor for your battery capacity estimation results.

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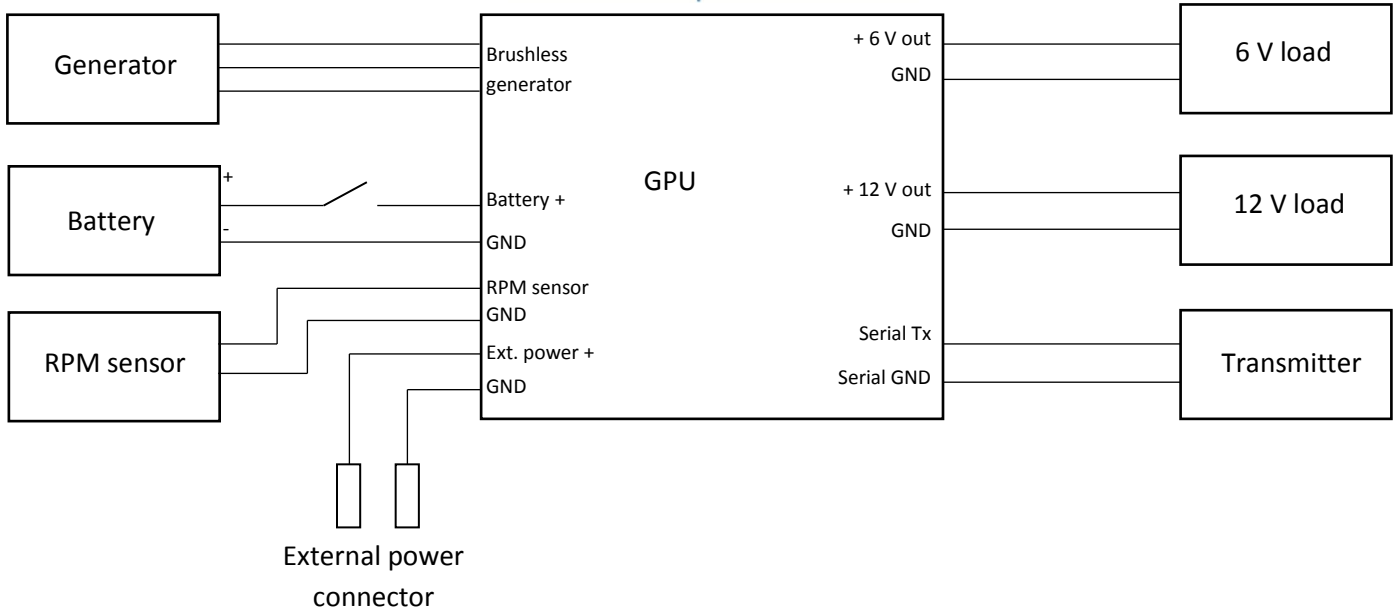


Figure 7 Typical connection diagram for brushless generator

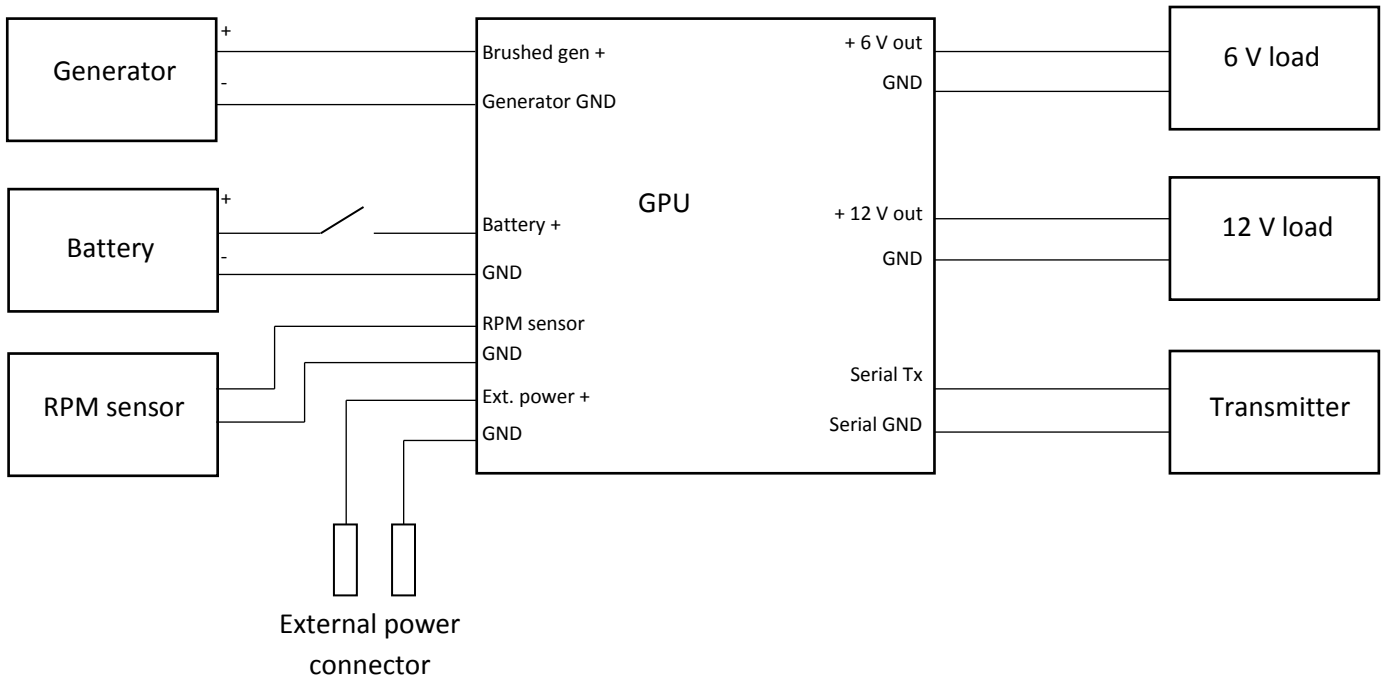


Figure 8 Typical connection diagram for brushed generator

5. Short circuit protection

The GPU has integrated short circuit protection for avoiding the regulator damage in case of a short circuit.

In case multiple loads are used on the same voltage line it is highly recommended to use fuses- this will allow the GPU to operate in the event of load short circuit. Please see Figure 9 for a diagram of fuse installation.

As an example, fuses can be installed before the payload, rf-transmitters as well as before the individual servos. If, for instance, there is a short-circuit in the payload - unmanned aircraft can still perform a safe landing.

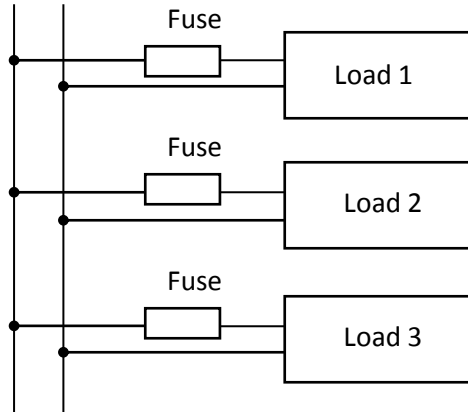


Figure 9 Installation of the fuse before each load will allow the GPU to supply power in case of the load short-circuit

6. Battery backup

External battery provides power supply to the system in case the input voltage drops below the battery voltage. This may occur because of several reasons:

- a) During engine idle, when generator provides insufficient voltage at the given load
- b) During pre-flight preparation when the engine is not operating and the external power supply is not connected
- c) During mechanical generator failure
- d) During engine failure

The following formula should be used to calculate approximate battery capacity for a particular UAV configuration:

$$\text{Battery capacity (Ah)} = \text{operation time (h)} \times \text{average load power (W)} / \text{battery voltage (V)} / 0.8$$

Where operation time is desired operation time, battery voltage is 11.1 V and 0.8 is regulator typical efficiency.



Do not use other type of battery except Lithium Polymer 3 cell battery. Maximum battery current should not exceed 8 A. When battery voltage is less than 12.6 V the charger charges the battery with current of <2 A. It is recommended to connect battery to the system through the switch with current rating not less than 10 A.

When the battery source is used, GPU is not producing exactly 12 volt power output, please see Figure 10 for details. The battery voltage and output voltage difference is approximately 0.4V and GPU cannot provide 12 V voltage if battery voltage is less than 12.4 V and starts to operate with 100 % duty cycle.

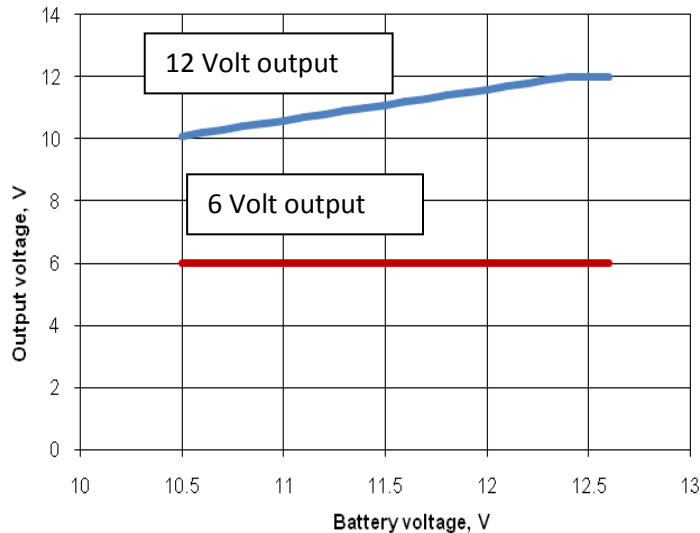


Figure 10 Output voltage in battery source mode

7. External Power Supply

External power supply can be used as a power source when the engine is no operating. This is especially useful for laboratory environment testing, during set-ups, during pre-flight checks on field as well as for charging the onboard battery. The input voltage range should be in range of 13-50 Volts.

8. Connector Description

GPU enclosure has two electrical connectors - J1 and J2, as seen on Figure 11. Pinout of J1 connector is shown in Figure 12 and is the same for both, brushed and brushless GPU configurations.

Please note, pinout of J2 connector is different for brushless and brushed GPU configurations. Figure 13 shows pinout configuration for brushless GPU option and Figure 14 shows pinout configuration for brushed GPU option.

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Figure 11 Input, Output connectors and status LEDs

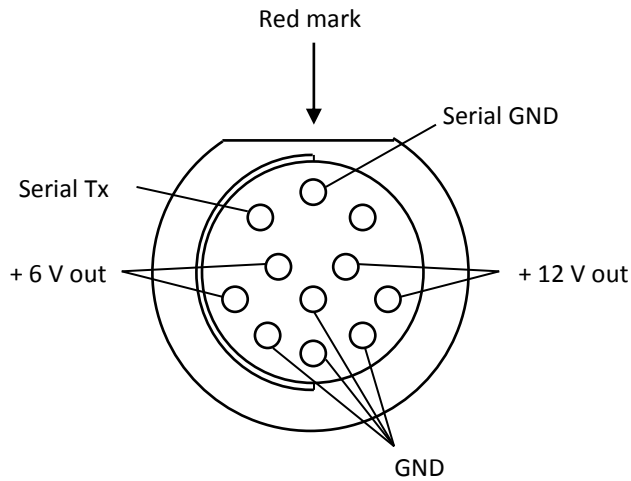


Figure 12 Connector J1 description

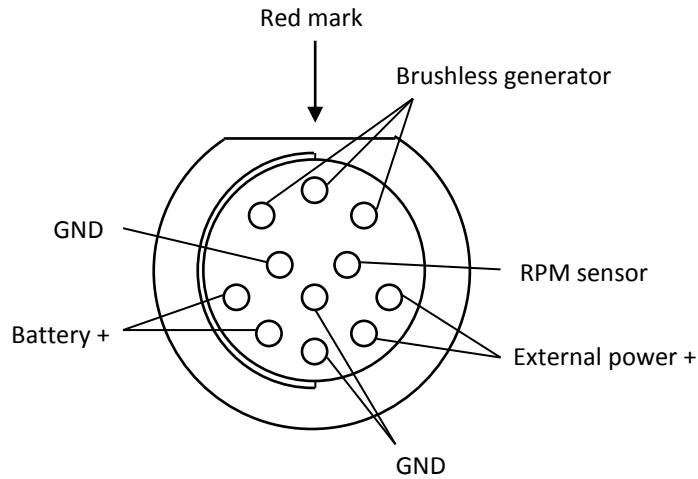


Figure 13 Connector J2 description (for brushless generator)

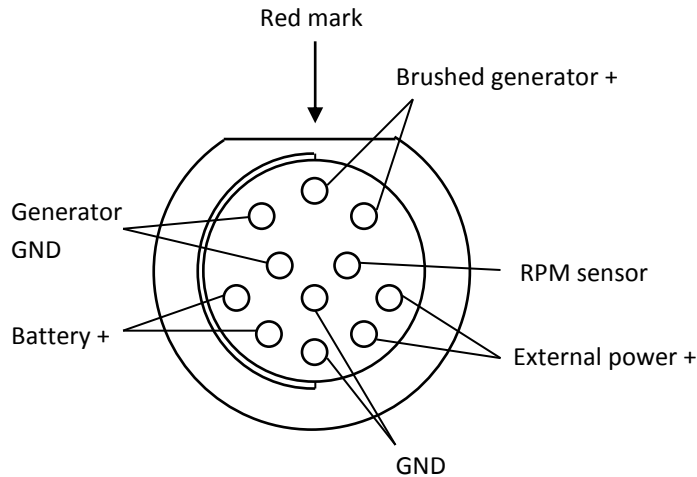


Figure 14 Connector J2 description (for brushed generator)

9. LED Indication

Four indication LEDs are located on the front side of the GPU, see Figure 11 for reference. The main purpose of LEDs is to facilitate set-up procedure, simplify pre-flight checks as well as to provide clear identification of the battery status before the flight. The following LED operation is implemented in the GPU:

6 V – green LED indicates 6 V voltage presence.

12 V – green LED indicates 12 V voltage presence.

BAT – green LED indicates that battery is supplying the system. When LED is off the generator or external power is supplying the system.

CHRG – red LED indicates battery charging. When LED is flashing the battery voltage is low and the generator provides not enough power.

10. Tachometer

Tachometer input allows to monitor engine or generator rotation speed using engine ignition system hall sensor. This reading can be sent through TTL port to autopilot and transmitted to the UAV ground station via the rf-link.

Connect signal output to RPM sensor input and ground pin to common ground of the power unit - see Figure 13 and Figure 14 for details.

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11. Serial communication

Serial communication allows to monitor system variables such as: generator and battery voltage, battery and load currents, total system power and RPM value.

Serial protocol uses 83 bytes packet and send it one per second, Figure 15 shows the output string format. This protocol is valid for GPU serial number starting from GPU0042. For older serial number, refer to the user manual version 1.4. Variables are separated with 3 spaces. The output string example is:

```
Rpm=3400 Vgen=27.3 Vbatt=11.82 Ibatt=-1.3 I6v=1.2 I12v=0.8 Pout=16
```

Rpm – rpm value

Vlin – internal line voltage

Vbatt – battery voltage

Ibatt – battery current (negative value for charging)

I6v – load current at 6 V line

I12v – load current at 12 V line

Pout – total output power

Serial communication settings:

Baud rate 9600

Bits 8

No parity

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B00	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16	B17
R	p	m	=						space	space	space	V	g	e	n	=	

B18	B19	B20	B21	B22	B23	B24	B25	B26	B27	B28	B29	B30	B31	B32	B33	B34
			space	space	space	v	b	a	t	t	=					

B35	B36	B37	B38	B39	B40	B41	B42	B43	B44	B45	B46	B47	B48	B49	B50	B51
space	space	space	l	b	a	t	t	=						space	space	space

B52	B53	B54	B55	B56	B57	B58	B59	B60	B61	B62	B63	B64	B65	B66	B67	B68
l	6	v	=				space	space	space	l	1	2	v	=		

B69	B70	B71	B72	B73	B74	B75	B76	B77	B78	B79	B80	B81	B82
	space	space	space	p	o	u	t	=				/r	/n

Figure 15 Output string format

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12. Cable set with plug for J1 and J2 wiring

Cable set with plug for J1 and J2 can be optionally ordered from UAV Factory. Figure 16 shows cable set schematic diagram for J1 and J2. Cable set is labeled to specify connection of each wire. For description of connections please refer to Table 1.

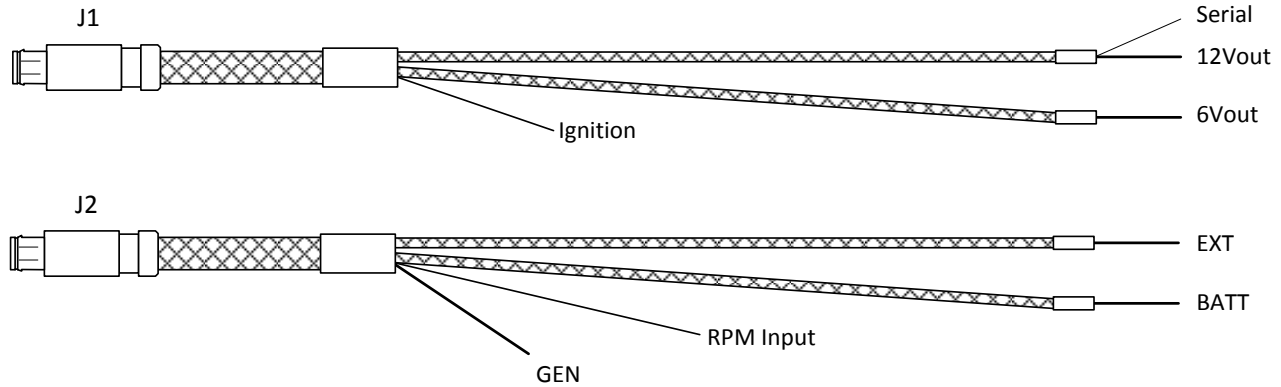


Figure 16 Cable set wiring schematic diagram

Table 1 Cable set description of connections

Label	Wire color	Connection description
GEN	red	Brushless generator phase A
	red	Brushless generator phase B
	red	Brushless generator phase C
GEN	red	Brushed generator "+" lead
	black	Brushed generator "-" lead
Ignition	red	Power output for ignition module (6V)
	black	Power ground for ignition module (GND)
RPM input	orange	RPM sensor input (Signal)
	black	RPM sensor ground (GND)
Serial	green	Serial interface output (Tx)
	black	Serial interface ground (GND)
BATT	red	Battery power input (3 Cell LiPo)
	black	Battery power ground (GND)
EXT	red	External power supply input (13-50V)
	black	External power ground GND)
6Vout	red	6V power output (6.0V)
	black	6V power ground (GND)
12Vout	red	12V power output (12.0V)
	black	12V power ground (GND)

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13. Order Information

Brushed version GPU100

Brushless version GPU100B

GPU Accessories		
Item	Order code	Qty
FISCHER cable plug for J1	S104A056	1
FISCHER cable plug for J2	S104Z056	1
Cable set with plug for J1, 50 cm	SJ105	1
Cable set with plug for J2, 50 cm	SJ205	1
Cable set with plug for J1, 100 cm	SJ110	1
Cable set with plug for J2, 100 cm	SJ210	1

14. User manual version history

Version	Comments, Updates	Date	Author
1.4	Voltage range is added for BLDC generator in electrical specification	5/15/2012	AG
1.5	Tachometer range is extended to 90000 rpm	2/11/2013	AG
1.6	Continuous load current at 12 Volt output is changed to 6A in electrical specification.	10/5/2013	AG

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