

## General Description

The Millswood Engineering 250W Power Management Unit provides up to 250 Watts of on-board electrical power generation for small to medium-sized UAVs. The -S version includes an integrated engine starter.

The 250W PMU simplifies UAV power distribution by providing multiple power outputs, which are individually programmable for voltage as well as being battery-backed. Dual (redundant) battery support is also included as standard.



**Figure 1: 250W PMU**

The PMU connects to a suitable brushless DC electric motor, which is in turn driven by the aircraft's primary power plant, usually an internal combustion engine.

## Features

- Optional engine starter may be activated locally via a momentary push-button switch, or remotely via command (facilitating in-flight engine restarts).
- Multiple independent, individually programmable power outputs:
  - Avionics: 12 – 21 VDC
  - Payload: 12 – 21 VDC
  - Servo: 5 – 12 VDCOutputs are battery-backed and switchable (on/off) via hardware signal or remotely via command.
- Dual (redundant) battery support. The PMU includes two independent and identical battery chargers. Supported battery types include:
  - LiPo: 5S, 6S
  - LiS: 7S, 8S, 9S, 10S
  - LiFe: 5S, 6S, 7S
- Industry-standard 28 VDC output (available during power generation and when the PMU is connected to umbilical power).
- RS232 and CAN control and monitoring interface provides extensive monitoring and reporting of voltages, currents, battery charge status, temperature.
- Buck-boost converter allows electrical power generation over 4:1 RPM range.
- Weight: 290 grams (10.2 ounces).
- Dimensions: 124.4 x 85.0 x 32.5mm.

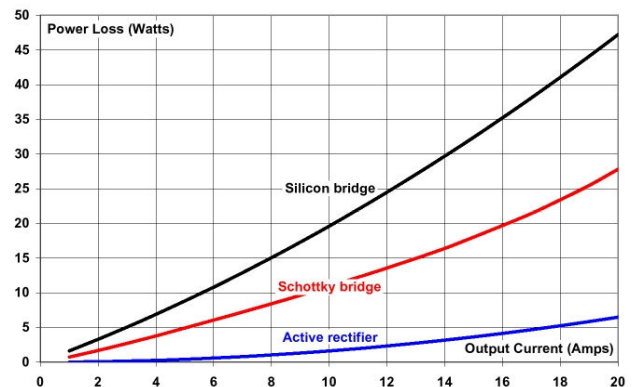
## Key technology – Active rectification

The first step in turning high-voltage AC into regulated DC is rectification. This process is traditionally performed using a diode bridge, which is an inefficient device that wastes some potentially useful power as heat. Active rectification replaces the diodes with FETs, which have lower loss than either Silicon or Schottky diodes.

As can be seen from figure 2, there is up to 90% reduction in the power lost in the rectification process when an active rectifier is used. This translates into improved overall efficiency, particularly at low rpm where the diode drop is a significant fraction of the rectifier's total voltage.

For the UAV, active rectification means:

- Reduced heating and heatsinking requirements and therefore smaller enclosed volume; and
- Operation to lower rpm.



**Figure 2: Power loss of a typical 3-phase Silicon diode bridge, a high-performance 3-phase Schottky diode bridge, and our 3-phase active rectifier**

## Key technology – Polyphase switching converter

The various power outputs (Avionics, Servo, Payload, and Battery Chargers) are implemented using a custom 5-phase DC-DC switching converter. This has significant advantages over using 5 separate switching converters.

Firstly, size is reduced. This is possible because the switching times of the converters are synchronised, each converter having its own unique phase offset. Input current demand is now evenly distributed over time, and so input capacitance sharing between converters can be realised, knowing that input currents can never be drawn simultaneously. Thus converter input capacitance volume can be reduced by almost a factor of 5 without incurring any performance penalty.

Secondly, the emitted noise spectrum is more predictable and can therefore be controlled more effectively. This is possible because the converters are all synchronised in time, thus ensuring that switching transients never sum unpredictably. This can be best appreciated by considering the system in the frequency domain, and noting that we no longer have 5 impulse spectrums mixing, we have just one. This represents a far simpler problem to solve.

These benefits do not compromise the independence of the individual converters. A load fault on one (or more) of the outputs does not propagate to the others; unaffected outputs retain full voltage and current authority.

For the UAV, a polyphase switching converter means:

- Reduced size and weight; and
- Reduced EMI.

## Specifications in brief

### **Electrical:**

BLDC motor voltage:	18 to 72 V <sub>PP</sub> (4:1 RPM range)
Umbilical power:	24 to 48 VDC
Battery voltage:	16.8 to 25.2 VDC
Battery chargers:	2 x 2.5 Amps, 120 Watts max.
Avionics output:	12 to 21 VDC, 7.5 Amps continuous, 120 Watts max.
Payload output:	12 to 21 VDC, 7.5 Amps continuous, 120 Watts max.
Servo output:	5 to 12 VDC, 10 Amps continuous, 120 Watts max.
28VDC output:	9.0 Amps continuous, 250 Watts max.

### **Miscellaneous:**

Environmental protection class:	IP50
Operating temperature range:	-40 to +70°C
Altitude rating:	10,000m
Cooling:	Natural convection, conduction and radiation
Enclosure:	Anodised aluminium
Dimensions:	124.4 x 85.0 x 32.5mm
Weight:	290 grams (excludes mating wiring harnesses)
Connectors:	Harwin M80 (combined signal/power) with jackscrews
Communications protocols:	RS232 (57600 8N1), CANbus

## Further Information

The information contained in this product brief is preliminary. For further information please contact Andrew Dunlop ([andrew@millswoodeng.com.au](mailto:andrew@millswoodeng.com.au)).

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