MILLSWOOD engineering

250W PMU

PRODUCT BRIEF

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. A variant manufactured for Currawong Engineering is available with an optional 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

- Buck-boost converter allows electrical power generation over 4:1 RPM range.
- Multiple independent, individually user-programmable power outputs:
  - Avionics: 12 – 21 VDC
  - Payload: 12 – 21 VDC
  - Servo: 5 – 12 VDC
- Outputs 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: 8S, 9S, 10S
  - LiFe: 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 interfaces provide extensive monitoring and reporting of voltages, currents, battery charge status and temperatures.
- Optional engine starter may be activated locally via a momentary push-button switch, or remotely via command to facilitate in-flight engine restarting (Currawong Engineering variant).
- 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.

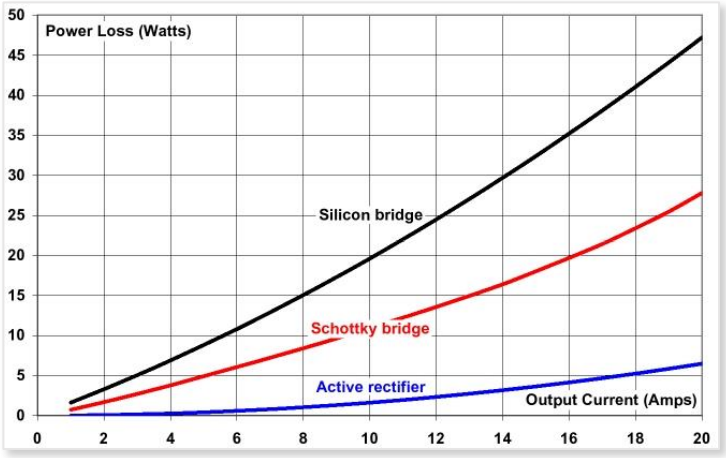

Figure 2 – Power loss of a typical 3-phase Silicon diode bridge, a 3-phase Schottky diode bridge, and our 3-phase active rectifier.

For the UAV, active rectification means:

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

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.**
- **Reduced EMI.**

Specifications in brief

Electrical:

BLDC motor voltage	18 to 72 V_{PP} (4:1 RPM range)
Umbilical power	24 to 48 VDC
Battery voltage	20.0 to 25.2 VDC
Battery chargers	2 x 1.2 Amps, 60 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 +85°C
Altitude rating	10,000m
Cooling	Integrated 28V fan
Enclosure	Lightweight custom-machined 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), CAN (1Mb/S)